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# THE BIOLOGICAL CONTROL OF AN INSECT IN FIJI

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ARNOLD (C. W. B.). **The Tobacco Aphis—a dangerous Pest.**—*Nyasaland agric. quart. J.* **2** no. 4 pp. 4–7. Blantyre, 1942.

The tobacco aphis [*Myzus persicae*, Sulz.] seriously affects the quality of tobacco crops in Nyasaland, where its wild food-plants comprise *Cleome monophylla* [*R.A.E.*, A **29** 154], which is common in the Southern Province, and the allied species, *Gynandropsis pentaphylla* [*cf.* also **31** 155], which is common in the Northern Province. In addition to feeding on the leaves of tobacco, this Aphid also transmits the rosette disease, which, however, is not very prevalent [*cf.* **29** 153]. Both alates and apterae occur in nursery beds.

To prevent infestation, all food-plants should be destroyed before the nursery beds are sown, the vegetation on a belt surrounding the site should be burned, and if the bed is near a stream, where wild food-plants are likely to survive, it should be separated from it by a belt of clean ploughed soil. The entrance of Aphids into the nursery can be restricted by the use of cloth covers. The beds nearest the stream should be examined daily and all infested plants destroyed ; plants in heavily infested beds and those in neighbouring beds that are not used for planting out should be buried and the soil above them well trampled down. In the author's experience, chemical control is unsatisfactory in nurseries, since sprays do not reach the Aphids on the under surfaces of the leaves, owing to the dense growth, and the Aphids in fumigated beds fall to the ground and migrate to other beds. Aphids on young plants with only three or four leaves in the field can be destroyed by removing all the foliage except the heart leaves and applying a solution of nicotine and soap as a spray or by means of small freshly prepared brushes made of fine grass, at intervals of 5 days. A strong tobacco infusion alone is as effective as nicotine with soap and has the advantage of staining the plants, which can thus be distinguished. It is prepared by heating 7 lb. tobacco scrap with 4 gals. water nearly to boiling point. The heating is necessary to destroy any mosaic virus [*Marmor tabaci* var. *vulgare* of Holmes] that the scrap may contain, which would otherwise be transmitted to the plants treated by the brushes.

NOBLE (N. S.). *Melittobia* (*Syntomosphyrum*) *indicum* (**Silv.**) (**Hymenopt., Chalcidoidea**), **a Parasite of the Queensland Fruit Fly,** *Strumeta tryoni* (**Frogg.**).—*Proc. Linn. Soc. N.S.W.* **67** pt. 3–4 pp. 269–276, 8 refs. Sydney, 1942.

*Dacus* (*Strumeta*) *ferrugineus tryoni*, Frogg., is now the dominant fruit-fly in New South Wales [*R.A.E.*, A **28** 290], where it attacks pome and stone fruits, and the larvae in most instances soon become deeply buried and beyond the reach of parasites ovipositing from outside the fruit. The only commonly occurring native parasite is *Opius* (*Diachasma*) *tryoni*, Cam., and the rate of parasitism by it is never high in cultivated fruits. In the summer of 1932–33, parasitised puparia of *Ceratitis capitata*, Wied., were obtained from Hawaii, and considerable numbers of *O. tryoni*, *Tetrastichus giffardianus*, Silv., *O.* (*D.*) *fullawayi*, Silv., and *O. humilis*, Silv., emerged from them. The last three were liberated but did not become established, and the only one that bred on *Dacus f. tryoni* in the laboratory was *T. giffardianus*, a single limited generation of which was obtained. Four species of *Opius* received from India in 1935 also failed to breed on *D. f. tryoni*. In view of the fact that *Syntomosphyrum* (*Melittobia*) *indicum*, Silv., is not specific, that numbers of native fruits in New South Wales are attacked by various species of *Dacus* (*Chaetodacus*) and that *S. indicum* enters the fruit in search of its host, a consignment of this Eulophid was obtained from India in 1937. It was reared in very large numbers on *D. f. tryoni* and was released on an extensive scale, but not recovered, both in New South Wales [*loc. cit.*] and in Queensland [*cf.* **27** 602]. It has, however, become established in Fiji [**29** 170], to which it was sent from New South Wales [against other species of *Dacus*].

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The methods used in rearing *S. indicum* in fruits infested with *D. f. tryoni* in the laboratory in New South Wales, where 11 generations were obtained between the end of October 1937 and the beginning of June 1938, and its biology are described. The adults fed freely on juice exuding from breaks in the fruits when introduced into the breeding cages and soon entered the fruits, often by holes through which mature fly larvae had left them. Ovipositing females lived not more than three days in summer ; they deposited several eggs in each host larva and many died without leaving the fruit. Oviposition occurred mainly within 24 hours after introduction into the cages, and under normal conditions rather more than 73 per cent. of the progeny were females, but unmated females apparently produced males only. The parasite larvae hatched before or after the host pupated, and themselves pupated within its puparium. The minimum life-cycle decreased from 24 days in the first generation (October–November) to 15 in the third and fourth in summer and increased to 22 days in the tenth and 32–33 in the eleventh in autumn ; in summer, the egg stage lasted about $2\frac{1}{2}$ days, the larval and prepupal stages together 7 days and the pupal stage $6\frac{1}{2}$. In tests in which individual females of different generations were caged with host larvae, 2–45 parasites developed in a single puparium ; the average number in the fourth, fifth and sixth generations was 23·41, although numbers of available host larvae remained unparasitised. When large numbers of parasites were present, the average yield of parasites per puparium was much higher, probably owing to superparasitism. The total progeny per female of 16 females ranged from 19 to 172, and the number of hosts attacked from 1 to 11. The percentage parasitism obtained in the laboratory with different numbers of parasites and hosts varied from 30·83 to 93·62 ; in the field, some larvae would always escape parasitism, since the parasites usually enter the fruit through openings made by fly larvae leaving to pupate. It is estimated that under conditions in New South Wales, *S. indicum* could pass through 12 generations in the year.

Williams (J. L.). **Heavy Infestation of Tent Caterpillars in Chester County, Pennsylvania (Lepidoptera : Lasiocampidae).**—*Ent. News* **53** no. 9 pp. 247–248, 3 refs. Philadelphia, Pa, 1942.

Infestation by *Malacosoma americana*, F., in Chester County, Pennsylvania, was heavier in the spring of 1942 than for several years. Apple trees were attacked more severely than usual, but less than wild cherry. Infestation of the latter was almost complete and some small trees bore 10–20 or more egg-rings, each consisting of about 180 eggs, in mid-June. It is the food-plant preferred by the larvae, and females kept with twigs of various trees usually selected cherry twigs for oviposition. The moths were caught for the first time in large numbers in a light-trap, which had been operated since 1936 ; males predominated, and most of the females had been fertilised. The females mate and oviposit only once.

Park (T.) & Burrows (W.). **The Reproduction of *Tribolium confusum* Duval in a semisynthetic Wood-dust Medium.**—*Physiol. Zool.* **15** no. 4 pp. 476–484, 2 figs., 15 refs. Chicago, Ill., 1942.

In the course of studies on the nutritional requirements of *Tribolium confusum*, Duv., a culture medium comprising 10 per cent. purified casein, 1 per cent. Osborne-Mendel mixture of inorganic salts, 3 per cent. dextrose and 5 per cent. dry yeast in 81 per cent. wood dust was found to be adequate for the maintenance of regular and continuous oviposition over periods as long as 60 days and of stock populations over several months. The rate of oviposition and the population densities of such stocks, however, compared unfavourably with those of others reared in flour. In wood-dust alone, few eggs were laid

and the beetles rapidly died out. The importance of the wood-dust medium lies in its value as a basis for the experimental demonstration of the more precise nutritional requirements.

FARRAR (M. D.) & FLINT (W. P.). **Control of Insects in fourteen thousand Corn Bins.**—*J. econ. Ent.* **35** no. 5 pp. 615–619, 1 ref. Menasha, Wis., 1942.

A preliminary survey carried out in Illinois in 1937 indicated that grain insects were abundant in growing maize as well as in that stored on the cob on farms. Shelled maize, delivered by the farmers in the autumns of 1939 and 1940 and stored in steel bins, sometimes showed symptoms of heating caused by insects within 30 days. Investigations on the control of these insects were begun in the autumn of 1939. It was found that some infestations develop in maize stored on the cob, and that when the maize is shelled and stored in 2,000-bushel steel bins, the insects develop at rates that depend on the moisture, the amount of cracked grain and foreign material, and the degree of infestation when the grain is brought from the farms. Important damage to stored maize by insects is indirect and occurs only when they become abundant and induce injurious conditions. These conditions can be associated with respiration, development of heat and moisture and condensation of moisture. Heavily infested grain that is not badly moulded returns to normal condition if the insects are destroyed, but it was shown that only clean grain of high quality could be held in bin storage for as long as two years in any part of Illinois without serious insect damage. Pests widely distributed in the State are *Plodia interpunctella*, Hb., which sometimes causes serious damage to surface grain ; *Calandra* (*Sitophilus*) *granaria*, L., which has been less destructive than was expected, but has survived all winter conditions ; *Tribolium castaneum*, Hbst., which causes occasional severe heating and has been difficult to control in heavily infested bins ; and *Laemophloeus ferrugineus*, Steph., *L. minutus*, Ol., *Oryzaephilus surinamensis*, L., *Ahasverus advena*, Waltl, *Typhaea stercorea*, L., and *Tenebroides mauritanicus*, L., which are important either alone or in combination with other species. *C.* (*S.*) *oryzae*, L., was widespread during the first year of storage, but was largely exterminated by winter temperatures. *Sitotroga cerealella*, Ol., caused severe damage in the southern area during the first year of storage, but only moderate damage in the central Illinois maize belt. *Cynaeus angustus*, Lec., and *Platydema ruficorne*, Sturm, were recorded as pests of stored maize for the first time in Illinois.

Much of the grain received had to be cleaned before it could be effectively fumigated. The difficulty of obtaining a satisfactory kill in the top 1–2 ins. of maize in the bins, as all the fumigants used are heavier than air, and in preventing rapid reinfestation of the top layer by insects entering the bin through the ventilator and openings under the eaves, was overcome by the addition of mineral oil (2–3 U.S. quarts per 1,000 bushels of grain), which mixes readily with all the fumigants that include an oil solvent and does not reduce their toxicity. This quantity gave excellent control of *Plodia interpunctella*, destroyed other insects that came in contact with the layer of oiled kernels, and did not affect the commercial quality of the grain. Twelve fumigants, many of them proprietary preparations, were tested at different dosages. Grain probes 11 ft. long, in which six gelatine cells [*cf. R.A.E.*, A **30** 527], each containing 90 living insects from a mixed culture of grain insects and an equal volume of wheat, had been placed at equal distances, were pushed into the grain, the fumigant was sprayed coarsely on the surface and the bin was closed and left undisturbed for 7–10 days. Comparison of the numbers of living insects in treated and untreated cells (which are detailed for the various species in a table) showed that proprietary mixtures of ethylene dichloride or propylene dichloride and carbon tetrachloride (3 : 1), both containing 10 per cent. methyl bromide, which gave consistently high kills at doses of 2 U.S. gals. (23 lb.) or

more per 1,000 bushels, were the most promising of the fumigants tested, but they are dangerous to the operators. Good control was obtained with carbon bisulphide and carbon tetrachloride (1 : 4) at 5 U.S. gals. (63·7 lb.) per 1,000 bushels and with carbon bisulphide at 1½ U.S. gals. (15·75 lb.), and satisfactory kills with 1 lb. chloropicrin or 2 lb. 1,1 dichloro-1-nitroethane each in 1 U.S. gal. (13·3 lb.) carbon tetrachloride, or with 5 U.S. gals. (56 lb.) ethylene dichloride and carbon tetrachloride (3 : 1). Methyl bromide alone was not satisfactory, owing to lack of even distribution of the gas through the grain.

FLOYD (E. H.), BECNEL (I. J.) & EDDY (C. O.). **Free Nicotine in Arsenical and Cryolite Dust Mixtures.**—*J. econ. Ent.* **35** no. 5 pp. 620–623. Menasha, Wis., 1942.

*Aphis gossypii*, Glov., the Pyralids, *Diaphania nitidalis*, Stoll, and *D. hyalinata*, L., and the twelve-spotted, banded and striped diabrotica beetles [*Diabrotica duodecimpunctata*, F., *D. balteata*, Lec., and *D. melanocephala*, F.] are destructive pests of cucumber in Louisiana, where it is impossible to grow the crop unless the Aphid is controlled to some extent, and the annual loss of fruit caused by *D. nitidalis* averages 25 per cent. in spite of the use of the recommended spray of lead arsenate and nicotine sulphate in Bordeaux mixture. A combined dust of cryolite, basic copper sulphate (as a fungicide) and free nicotine or nicotine sulphate did not control the Aphid, apparently because the nicotine was adsorbed by the other materials and released too slowly to be effective, but was promising otherwise, and experiments in 1941 showed that an efficient nicotine dust could be prepared with Black Leaf 10 (10 per cent. nicotine from pure nicotine alkaloid adsorbed on finely divided tobacco dust). The yield from plots dusted eight times at the average rate of 14·1 lb. per acre with a mixture of 33 per cent. cryolite, basic copper sulphate to give 7 per cent. copper, Black Leaf 10 to give 1 per cent. nicotine and Pyrax ABB (pyrophyllite, pH 6·9) as the carrier, and twice, when Aphids were not present, with the same dust omitting the nicotine was 59·27 lb., as compared with 38·53 and 20·53 lb., respectively, from plots treated with standard spray and with the same dust omitting the nicotine in all applications, the percentages of fruits infested by the Pyralids being 0, 23·12 and 1·8 and the percentages of plants injured by Aphids 0·8, 1·6 and 72·5, respectively. Dusts containing 1 per cent. rotenone and basic copper sulphate were ineffective against the Aphid in 1940, but effective in 1941, and gave less control of the other pests than those containing cryolite. Pyrethrum and other forms of nicotine were unsuitable as aphicides in the mixture.

On squash, dusts of 33 per cent. cryolite and 7 per cent. copper in pyrophyllite, alone or with the addition of 0·5 per cent. nicotine from Black Leaf 10 or from free nicotine or of 1 per cent. rotenone resulted in 88·12, 126·37, 84·75 and 97·75 lb. fruit, respectively. Since Aphids were not present on these plots, the significantly higher yield from those receiving Black Leaf 10 may have been due to the fact that the rate of application of this dust was rather heavier, but it reduced infestation by *Diaphania* to less than half that on any of the other plots.

Laboratory tests in which dusts containing 2 per cent. nicotine from Black Leaf 10 in different diluents were tested against the Aphid showed that it was effective and compatible with all the materials used ; its toxicity varied little when it was mixed with various clays, tobacco stem dust, Pyrax ABB, wheat flour, lime or walnut-shell flour, but it was only half as toxic with cryolite and intermediate in toxicity with calcium arsenate.

In one field experiment, calcium arsenate dusts containing 1 per cent. nicotine from Black Leaf 10 or nicotine sulphate and a 1 per cent. nicotine-lime dust were equally effective in reducing the population of *A. gossypii*, and in another

Black Leaf 10 was the most effective aphicide used with calcium arsenate for the control of the boll weevil [*Anthonomus grandis*, Boh.] on cotton [*cf.* next abstract].

BECNEL (I. J.) & FLOYD (E. H.). **Insecticide Tests for Cotton Aphid and Boll Weevil Control during 1941.**—*J. econ. Ent.* **35** no. 5 pp. 623–626. Menasha, Wis., 1942.

Experiments to study the effect of *Aphis gossypii*, Glov., on the yield of seed cotton in a programme for the control of the boll weevil (*Anthonomus grandis*, Boh.), and to determine the effectiveness of several aphicides in combination with calcium arsenate were carried out in 1941 in two localities in Louisiana in which the Aphid occurs nearly every year and frequently causes considerable early defoliation. Aphid infestation was uniform on all plots at the beginning of the experiments. The dusts were applied in the late afternoon on 25th and 30th July and 4th, 8th and 18th August in one locality and on 18th, 22nd and 27th July and 1st, 7th and 20th August in the other. In the first, all the dusts caused significant reductions in boll-weevil infestation over the control plots; one of calcium arsenate and 1 per cent. nicotine in the form of Black Leaf 10 [see preceding abstract] resulted in significantly higher yields and lower Aphid infestation than any other treatment and in boll-weevil infestation similar to those on plots treated with calcium arsenate alone or with 10 per cent. sulphur and 0·5 per cent. rotenone in the form of derris (5 per cent. rotenone), and significantly lower than on that treated with calcium arsenate, 10 per cent. sulphur and 0·2 per cent. pyrethrins in the form of Pyrocide (2 per cent. pyrethrins). Aphids were more numerous on plots treated with calcium arsenate alone or with sulphur and pyrethrins and less numerous on that treated with calcium arsenate, sulphur and rotenone than on the control plot, the last two differences being significant. There were no appreciable differences in lint grades or length. In the other locality, where the same dusts were applied, yields were significantly higher on plots treated with those containing sulphur and rotenone or nicotine than on any others, and the numbers of Aphids were significantly less on these and the control plot than on the others. Boll-weevil infestation was heaviest on the control plot and not significantly lower on those receiving calcium arsenate with sulphur and pyrethrins or rotenone, but significantly lower on those treated with calcium arsenate alone or with nicotine than on the first two. The plants treated with nicotine, which bore very low populations of Aphids, kept their foliage for considerably longer than those on the other plots. In the two experiments, calcium arsenate alone, with nicotine, with sulphur and rotenone and with sulphur and pyrethrins resulted in average increases in yield of 323, 359, 168 and 258 lb. seed cotton per acre, respectively, over the control plots.

EWING (K. P.) & MORELAND (R. W.). **Insecticides to control Bollworm, Boll Weevil, Cotton Aphid, and Cotton Flea Hopper.**—*J. econ. Ent.* **35** no. 5 pp. 626–629, 1 ref. Menasha, Wis., 1942.

In field-plot experiments against *Heliothis armigera*, Hb., on cotton in Texas, in which the dusts or spray were applied four times between 31st July and 20th August 1941, a mixture of basic copper arsenate and hydrated lime (1 : 1), lead arsenate, synthetic cryolite (84·9 per cent. sodium fluoaluminate) and calcium arsenate gave yields of 539, 419, 347 and 321 lb. seed cotton per acre more than the control plot (564 lb.) in one test, and lead arsenate, natural cryolite, a lead arsenate spray and a mixture of calcium arsenate and Paris green (92·5 : 7·5) gave 569, 497, 473 and 439 lb. more than the control plot (411) in another [*cf. R.A.E.*, A **30** 254]. No appreciable damage was caused by *Anthonomus grandis*, Boh., or *Aphis gossypii*, Glov.;

the latter became abundant soon after dusting began, but was effectively controlled in all plots with a dust of 3 per cent. nicotine in lime, applied on 18th August. The control plots were dusted on 22nd and 29th August and the cryolite plots on 29th August with a mixture of 14 per cent. Paris green in lime to prevent defoliation by *Alabama argillacea*, Hb., which was effectively controlled for several weeks by all the other insecticides. In further experiments against *H. armigera*, *Anthonomus grandis* and the Aphid, basic copper arsenate and sulphur (1 : 1), zinc-safened calcium arsenate (3·7 per cent. zinc oxide), and calcium arsenate alone and with 0·5 per cent. rotenone as derris increased the yield of seed cotton per acre from 781 to 1,530, 1,393, 1,216 and 1,173 lb., and (in another test) calcium arsenate alone, or with nicotine sulphate (1 per cent. nicotine), derris (0·5 per cent. rotenone), 10 per cent. zinc arsenate, or 7·5 per cent. each of zinc sulphate and hydrated lime increased it to 1,218, 1,335, 1,276, 1,227 and 1,147 lb. The mixture of basic copper arsenate and sulphur gave effective control of the weevil, reduced infestation by *Heliothis* more than any other treatment, and resulted in a smaller increase in infestation by the Aphid than any dust except the one containing nicotine ; the copper and sulphur in the mixture may have had a slight stimulating effect on the plants.

In experiments against *Psallus seriatus*, Reut., on plots in which *H. armigera* and *A. grandis* did practically no damage, three or four effective applications, between 24th June and 18th July, of basic copper arsenate and sulphur (1 : 2) calcium arsenate and sulphur (1 : 2), micronised Paris green and sulphur (7·5 : 92·5) and sulphur alone increased the yield of seed cotton from 753 to 1,041, 978, 944 and 881 lb. per acre, respectively, and reduced the numbers of the Capsid from 38·3 to 10·8, 10·6, 9·5 and 12·3 per 100 terminals.

EYER (J. R.) & MEDLER (J. T.). **Control of Hemipterous Cotton Insects by the Use of Dusts.**—*J. econ. Ent.* **35** no. 5 pp. 630–634, 1 fig. Menasha, Wis., 1942.

The following is based on the authors' summary. Of the Rhynchota that injure cotton in the irrigated valleys of southern New Mexico, the most important are *Adelphocoris superbus*, Uhl., and species of the genera *Lygus* and *Chlorochroa*. In a randomised block experiment at State College in 1941, substantial increases in yield of seed cotton were obtained with dusts of Paris green and sulphur and calcium arsenate and sulphur, but not with sulphur alone. These arsenical-sulphur combinations also produced relatively high mortalities of *C. sayi*, Stål, *L. hesperus*, Knight, and *A. superbus* in large field cages ; sulphur alone was again ineffective.

CHAMBERLIN (F. S.) & MADDEN (A. H.). **Control of Flea Beetles on Cigar-Wrapper Tobacco with Cube Dust in the Florida-Georgia Area.**—*J. econ. Ent.* **35** no. 5 pp. 634–637, 3 refs. Menasha, Wis., 1942.

As it is known that *Epitrix parvula*, F., can be controlled on shade-grown cigar-wrapper tobacco in Florida and Georgia with cubé or derris dusts containing 1 per cent. rotenone [*cf. R.A.E.*, A **26** 132 ; **30** 44], field experiments were carried out in Florida during 1938–40 to determine the number of applications necessary and when they should be made. Powdered sterilised tobacco containing powdered cubé root to give a rotenone content of 1 per cent. was applied in the early morning at a dosage of 4 lb. per acre when the plants were about 2 ft. high and at 6 lb. per acre when they were larger. Applications were begun soon after transplanting and were made at intervals of 3–4, 7, 10 and 14 days, the total number in the season depending on the severity of the infestation. Eleven applications at weekly intervals gave the most economical control under conditions of heavy infestation, whereas three at 10-day intervals were sufficient when infestation was very light. Owing, however, to the low cost of

control as compared with the value of the crop and to the difficulty of determining the extent of infestation under field conditions, it is considered undesirable to limit the number of applications to the minimum that appears necessary to prevent damage. Weekly applications from transplanting time until the crop approaches maturity will normally give adequate protection.

MATHES (R.) & INGRAM (J. W.). **Development and Use of Sugarcane Varieties resistant to the Sugarcane Borer.**—*J. econ. Ent.* **35** no. 5 pp. 638–642, 1 ref. Menasha, Wis., 1942.

A preliminary account is given of investigations in the United States in 1936–41 on the resistance of sugar-cane to the sugar-cane borer [*Diatraea saccharalis*, F.]. The degree of resistance of common varieties and the comparative susceptibility to injury of several promising new varieties that are potentially suitable for release to growers are discussed, and attempts to develop new resistant varieties are described. Approximately 7,000 varieties were examined, and 106 with the lowest average infestation were tested by artificial infestation; four of these that maintained their resistant status throughout the tests were selected as parents to be used in crosses designed to increase the element of resistance and to transfer it to agronomically desirable varieties adapted to specific localities. Studies were made of the comparative susceptibility of different hybrids, to determine the extent to which certain parents tend to produce borer-resistant progeny, and of several plant characters that might be associated with resistance. No definite relation was found between hardness of rind or fibre content of the stalk or leaf spindle and borer injury, possibly owing to the small number of varieties tested; older stalks were less heavily infested than young ones, although they were exposed to attack for longer, indicating the advisability of planting varieties that produce a large number of early stalks; higher percentages of internodes were bored in varieties with large stalk diameters; and varieties with stalks containing a relatively large amount of pith were more severely damaged than those with a small amount. Varieties with the shortest and lightest stalks and with least sucrose were the most severely bored, though these conditions may have been the result rather than the cause of severe injury. There was no relation between borer injury and the colour of the stalks, the width of the leaves or ease of stripping.

SCARAMUZZA (L. C.) & INGRAM (J. W.). **Results attained in the biological Control of *Diatraea saccharalis* (F.) in Florida.**—*J. econ. Ent.* **35** no. 5 pp. 642–645, 6 refs. Menasha, Wis., 1942.

The authors briefly review attempts in 1926–36 to establish insect parasites of *Diatraea saccharalis*, F., on sugar-cane in Florida [*cf. R.A.E.*, A **26** 390; **27** 656, 658; **30** 412] and describe the programme begun in 1938 of breeding and releasing annually large numbers of parasites at Fellsmere, where the Pyralid is more injurious than in the neighbourhood of Lake Okeechobee, the other main sugar-producing area in southern Florida. *Microdus* (*Bassus*) *stigmaterus*, Cress., which is widely distributed in the area, was not found at Fellsmere, but cane from a district where it was fairly common was piled beside the fields [*cf.* **30** 412]. During 1938, 1,405 mated females of the Tachinid, *Lixophaga diatraeae*, Tns., from stock imported from Cuba and Porto Rico were released, and examination of 10 fields in October showed that it wa established in each of them, the percentage parasitism averaging about 10. Cane harvested in the following February was unusually lightly infested, probably owing to this parasite. It survived cold weather in winter, and attacked about 4 per cent. of the borers in some fields in April 1939. In that year, a further 800 mated females of *Lixophaga* and 400 adults of both sexes of the São Paulo strain of *Metagonistylum minense*, Tns., were released. *Microdus* was

found in June, and the percentages of parasitism by it and *Lixophaga* were 3·3 and 8·6, respectively, in July, and 21·5 and 30·6 in October ; that by *Metagonistylum* reached 4·6 in October. In 1940, 1,170 mated females of *Lixophaga* and 270 adults of *Metagonistylum* were liberated, and parasitism by *Microdus* was about 2 per cent. in July. In spite of low winter temperatures, small numbers of *Lixophaga* and *Microdus* were active in May 1941 ; 3,139 and 160 mated females of *Lixophaga* and *Metagonistylum*, respectively, were liberated, and the combined percentage parasitism by *Lixophaga* and *Microdus* in some fields rose from 10–15 in June to almost 70 in mid-October ; parasitism by *Metagonistylum* was very low.

At the end of October, it was estimated that less than 30 per cent. of the stalks were bored, and most damage had been done at the beginning of the growing season. The great abundance of parasites resulted in superparasitism of the available host larvae, and several instances of parasitism of a single host by a larva of *Lixophaga* and one of *Microdus* were observed, both parasite larvae dying before pupation.

In June 1941, the Braconid, *Macrocentrus crambi*, Ashm., was found parasitising one larva of *Diatraea saccharalis*, and in July several examples of an Ichneumonid of the genus *Cremastus* were found in larvae of the borer or pupating in their tunnels. Other parasites that were introduced at Fellsmere but not recovered include *Apanteles diatraeae*, Mues., *Theresia claripalpis*, Wulp, and *Chelonus annulipes*, Wesm.

MORRILL jr. (A. W.). **Control of the Tobacco Thrips on Shade-grown Tobacco in Connecticut.**—*J. econ. Ent.* **35** no. 5 pp. 646–649, 1 fig., 3 refs. Menasha, Wis., 1942.

Preliminary tests in 1936 and 1937 with sprays of nicotine, pyrethrum, lauryl thiocyanate and cubé and a dust of cubé against *Frankliniella fusca*, Hinds, on shade-grown tobacco in Connecticut having shown that though none of the insecticides gave satisfactory control, the pyrethrum and cubé sprays were promising [*cf. R.A.E.*, A **27** 177], dusts and sprays of these two materials were tested against the thrips and *Epitrix cucumeris*, Harr., in an effort to obtain simultaneous control of both. The results for *Epitrix* have been published elsewhere [*cf.* **30** 40, 130]. In tests in 1938–41 with dusts of cubé and sterilised tobacco dust (approximately 1 per cent. rotenone), with or without a conditioning agent, and of exhausted pyrethrum flowers impregnated with the active principles of pyrethrum and about 0·2 per cent. petroleum oil (0·4–1 per cent. total pyrethrins) and sprays of cubé and a conditioning agent and of pyrethrum extract with cubé and sulphated castor oil or with derris extract and glycerol, the pyrethrum dusts caused a significantly greater reduction of thrips population and of damage to the cured leaves due to thrips feeding than any other treatment. Although this material does not give complete control and is comparatively expensive, the reduction in loss is sufficient to make its use profitable.

GLASGOW (H.). **The Place of concentrated Sprays in the Pea Aphid Control Program.**—*J. econ. Ent.* **35** no. 5 pp. 649–653, 3 figs., 1 ref. Menasha, Wis., 1942.

The following is based on the author's summary of this paper, in which are recorded the results obtained with concentrated sprays of rotenone extract or nicotine sulphate in water or of free nicotine alone or with rotenone extract in oil against the pea Aphid [*Macrosiphum onobrychis*, Boy.] on peas grown for canning in New York [*cf. R.A.E.*, A **30** 569]. Although concentrated sprays have in many cases given a relatively high degree of control both in experimental work and on a commercial basis, they have, at present, certain limitations. In some combinations, particularly where oils are used as the carrier,

the concentration of the spray may be so great that foliage injury occasionally results, and in any case the margin of safety is likely to be narrow. Moreover, it is possible that highly concentrated sprays may exert a retarding influence on the crop that may be reflected in the final yield, even though no noticeable injury is apparent at the time of application. It has also been noted that on extremely hot, windy days, the water sprays seem to evaporate rapidly before even reaching the plants, so that the kill is greatly reduced. In order to ensure adequate coverage at the greatly reduced volume ordinarily used in sprays of this type, they must be broken up into a very fine, mist-like condition, and the difficulty of protecting such sprays, which closely approximate to dusts in many of their physical properties, from displacement by air currents during application and of ensuring uniform coverage is much greater than with ordinary sprays. This weakness, while partly overcome in some types of equipment by a supplementary air blast designed to carry the finely divided spray into the foliage, or by equipping the boom with protecting hoods or baffles to minimise the effects of air currents, is the most serious obstacle to a more general acceptance of this method of application. Although the most effective insecticide combination and the best equipment are not yet known, the results are promising and merit consideration.

BOHART (R. M.) & MALLIS (A.). **The Control of Pillbugs and Sowbugs.**—*J. econ. Ent.* **35** no. 5 pp. 654–658, 7 refs. Menasha, Wis., 1942.

*Armadillidium vulgare*, Latr., and *Porcellio laevis*, Latr., which have world-wide distribution, are injurious to seedlings in gardens, lathhouses and greenhouses, and under favourable conditions may attack field crops, particularly leguminous ones ; in the San Joaquin Valley of California they have been reported as injuring cotton seedlings following lucerne in rotation. They also separate the earth from the sides of the benches in greenhouses, causing uneven drainage, devour fertilisers and girdle the plants at or near ground level, and sometimes congregate in large numbers in the moist basements of dwellings. In laboratory tests carried out in California between December 1940 and May 1941, batches of 50 adults of *A. vulgare*, which is more resistant to insecticides than *P. laevis*, were placed in dishes with a bottom area of 7 sq. ins. and covered with 50 gm. moist earth ; the earth was then dusted with a weighed amount of insecticide. At a dosage of 5 lb. per 1,000 sq. ft., basic lead arsenate, tartar emetic, sodium fluoride, natural cryolite, dicyclohexylamine dinitro-o-cyclohexylphenate, nicotine bentonite (5 per cent. nicotine), nicotine sulphate dust (10 per cent. nicotine sulphate), derris dust (two mixtures), phenothiazine, sulphur dust and hydrated lime were ineffective ; acid lead arsenate, cuprous carbonate, sodium fluosilicate and pyrethrum dust (0·2 per cent. pyrethrins) gave 64–83 per cent. mortality after three weeks ; white arsenic gave 97 per cent. ; and mercuric chloride, sodium arsenite, Paris green, mercurous chloride, sodium arsenate, manganese arsenate, calcium arsenate and cuprous cyanide, which are arranged in order of decreasing toxicity, based on lower dosages, gave 100 per cent. in one or two weeks. Of these, calcium arsenate appears to be the most practical from the standpoint of cost, availability and plant injury. The presence of flour, which was used as a diluent, adhesive and attractant, accelerated the kill, but did not seem to affect the final mortality.

In a separate laboratory experiment, it was observed that Paris green and cuprous cyanide were capable of causing considerable mortality purely by contact with the under surface of the body ; calcium arsenate was less toxic as a contact poison. In field tests against both *A. vulgare* and *P. laevis*, calcium arsenate, applied at the rate of 3–5 lb. per 1,000 sq. ft., alone or with flour, gave satisfactory results.

LEHMAN (R. S.). **Laboratory Tests of organic Fumigants for Wireworms.**—*J. econ. Ent.* **35** no. 5 pp. 659–661, 4 refs. Menasha, Wis., 1942.

A description, with tabulated results, is given of laboratory experiments in which 114 liquid organic compounds were tested as fumigants against wireworms, particularly *Pheletes* (*Limonius*) *canus*, Lec., and *P.* (*L.*) *californicus*, Mannh., in soil, and the median lethal dosages were determined for 57 of them. Those more toxic than carbon bisulphide were allyl isothiocyanate, ethyl isothiocyanate, allyl bromide, chloropicrin, methyl iodide, allyl iodide, methyl bromide, methyl disulphide, allyl chloride and epichlorohydrin, in descending order of toxicity. Of nine compounds shown by Lehman to be more toxic than carbon bisulphide in air [*cf. R.A.E.*, A **22** 90], only allyl isothiocyanate, chloropicrin and epichlorohydrin were more toxic in the soil, and the differences in their toxicities were much less. The soil evidently absorbs much of the fumigant, making it less available to the insect, and unpublished tests have shown that diffusion is important in the field. Thus, chloropicrin, which is 14·3 times as toxic as carbon bisulphide in soil in the laboratory, is only twice as toxic in the field, and allyl isothiocyanate, which is 29·3 times as toxic in the laboratory, has about the same toxicity in the field. The greater toxicity of carbon bisulphide in the field is probably due to its ability to diffuse and its small loss by absorption in the soil.

RICHARDSON (H. H.) & CASANGES (A. H.). **Toxicity of Acrylonitrile, Chloroacetonitrile, Ethylene Dichloride and other Fumigants to the Confused Flour Beetle.**—*J. econ. Ent.* **35** no. 5 pp. 664–668, 2 figs., 16 refs. Menasha, Wis., 1942.

The following is substantially the authors' summary. Laboratory tests of the toxicity of certain chemicals as fumigants were made against *Tribolium confusum*, Duv., in 5-hour exposures at 25°C. [77°F.]. Small volumes of chemicals as volatile as carbon bisulphide were conveniently measured by the use of a small hypodermic syringe attached to a micropipette. Acrylonitrile and chloroacetonitrile were the most toxic chemicals and appear worth further study as fumigants. They were also very toxic to *Cimex lectularius*, L. Other chemicals tested are listed by groups approximately in the order of decreasing toxicity, as follows: (1) Methyl bromide, 1,1-dichloro-1-nitropropane, and 1,1-dichloro-1-nitroethane; (2) methyl allyl chloride, methyl allyl bromide, and ethylene oxide; (3) carbon bisulphide; and (4) ethyl bromide.

Ethylene dichloride was found to have a delayed killing action, which increased mortality considerably over a period of about 20 days after fumigation. A non-inflammable mixture with carbon tetrachloride (3 : 1 by volume) also showed a latent effect, but the carbon tetrachloride added little or nothing to toxicity. Judged only from the mortality produced after 20 days, ethylene dichloride is not far below methyl bromide in the toxicity scale. However, beetles fumigated with these low concentrations of ethylene dichloride may lay viable eggs before death, and the dosages must be increased to prevent egg-laying.

JOHNSON (A. C.), LIVINGSTONE (E. M.) & BULGER (J. W.). **Methyl Bromide Fumigation to control Oriental Fruit Moth on dormant Nursery Stock.**—*J. econ. Ent.* **35** no. 5 pp. 674–677, 2 figs., 5 refs. Menasha, Wis., 1942.

Investigations undertaken in 1938–40 to develop a quick and economical method of destroying *Cydia* (*Grapholitha*) *molesta*, Busck, on nursery stock grown in infested areas in the eastern United States so that it may safely be shipped to the western States are described. In summer, larvae are present in the pulp of fleshy fruits and the tips of tender twigs of several species of cultivated trees and shrubs, and in winter they hibernate in cocoons that are often

situated under flakes of loose bark or in crevices of healed wounds. These cocoons are found on nursery stock throughout the dormant season. Tests in which hibernating larvae were suspended in bottles into which fumigants were introduced showed that methyl bromide was more toxic than trichlorethylene, ethyl formate, and ethylene dichloride alone or with ethylene oxide (3 : 1) and that some larvae survived at dosages of 1 lb. methyl bromide per 1,000 cu. ft. for 3 hours at approximately 70°F. and with 4 lb. methyl bromide for 3 or 4 hours at about 50°. Commercial tests were therefore carried out with the eggs, overwintering larvae, pupae and adults, which were exposed at atmospheric pressure to methyl bromide for 4 hours in a fumigating chamber of approximately the same size and shape as a crate for nursery stock. The lowest dosages per 1,000 cu. ft. that gave complete mortality at 60 and 70°F., respectively, were 2·5 and 2 lb. for eggs 2–13 days old on pear leaves, 1·5 and 1 lb. for larvae in cocoons in strips of corrugated paper, small bundles of twigs or holes in peach twigs, and 2·5 and 1·5 lb. for pupae in cocoons in corrugated paper. All newly emerged adults were killed by 0·5 lb. at 60°, and 0·25 lb. at approximately 75°. At a pressure of 2 ins. mercury (28-inch vacuum), complete mortality was obtained with dosages of 1 lb. for 2 hours at 70°, with 2 lb. for 4 hours at 55°, and with 4 lb. for 2 hours at approximately 50°, but one of 1 lb. for 2 or 4 hours at about 45° did not kill all the larvae.

In 1938, the use of 3·5 lb. methyl bromide per 1,000 cu. ft. for 4 hours at 70°F. was recommended, but this dosage caused some tip injury, and further experiments showed that 4 hours' exposure to 2 lb. per 1,000 cu. ft. at 70° or 3 lb. at 60° was adequate, and this treatment was accepted by the western States.

Gobeil (A. R.). **Diapause and Egg Intoxication in *Diprion polytomum* Hartig.**—*J. econ. Ent.* **35** no. 5 pp. 677–679, 2 refs. Menasha, Wis., 1942.

Since Roubaud inferred from experiments with *Phlebotomus papatasii*, Scop., that when the deposition of eggs by the female is delayed for 8–10 days the larvae undergo a diapause, independent of low temperatures, resulting from hereditary intoxication caused by the accumulation of excretory products in the organism [*cf. R.A.E.*, B **16** 183 ; **23** 197], the author carried out experiments in Canada with *Gilpinia hercyniae*, Htg. (*Diprion polytomum*, auct.) to determine whether diapause in this species could be explained in the same way. Since the degree of intoxication should vary with the age, activity and food of the female, the females used were divided into four groups, which were confined in a dark and cool environment (50–55°F.) so that they wasted the minimum of energy ; left in daylight in the laboratory, where the temperature averaged 60°F. at night and 70° in daytime, with sugared water as food ; kept under the same conditions but without food ; and placed on fresh foliage for oviposition immediately after emergence and transferred to new foliage every two days. The duration of diapause of the resulting larvae appeared to be entirely independent of the retention period of the mature eggs in the ovaries, and the author therefore considers that Roubaud's hypothesis does not hold good for *G. hercyniae*.

White (R. T.) & Dutky (S. R.). **Cooperative Distribution of Organisms causing Milky Disease of Japanese Beetle Grubs.**—*J. econ. Ent.* **35** no. 5 pp. 679–682, 3 refs. Menasha, Wis., 1942.

A brief account is given of the extensive programme of distribution of *Bacillus popilliae* and *B. lentimorbus*, which cause milky disease in the larvae of *Popillia japonica*, Newm. [*cf. R.A.E.*, A **29** 369], that has been undertaken by the U.S. Bureau of Entomology and a number of cooperating State and Federal agencies ; the paper deals chiefly with the first species, which is the commoner. The organisms are propagated to the spore stage in the bodies of the larvae and applied to the ground in a water suspension or as a dust in talc

[*cf.* **29** 125]. It has been found that 2 gm. standard dust (200 million spores) applied over approximately 1 sq. ft. at intervals of 10 ft. where a moderate to high larval population occurs will be distributed throughout the untreated portions by local migration of the larvae within three larval feeding seasons, and this treatment has been chosen for colonisation work in most areas. The cooperative programme arranged with eleven States and the District of Columbia, details of which have been varied to meet the specific needs of the agencies involved, are briefly discussed, and the progress made by 1st November 1941 is shown. As a result of this programme, nearly 21,000 acres, comprising 25,593 colony sites, have been treated with milky disease in the heavily infested areas and, in addition, 260 experimental plots in seven States and the District of Columbia serve also as colonisation sites.

Henderson (C. F.) & Holloway (J. K.). **Influence of Leaf Age and Feeding Injury on the Citrus Red Mite.**—*J. econ. Ent.* **35** no. 5 pp. 683–686. Menasha, Wis., 1942.

Since populations of *Paratetranychus citri*, McG., on *Citrus* often decrease rapidly although climatic conditions are apparently favourable and natural enemies scarce, laboratory experiments were carried out to evaluate the effect of the density of the mite and the resultant feeding injury to *Citrus* leaves on its productivity and length of life. Orange leaves were placed in individual cages, subjected to light, medium and heavy feeding injury by varying the numbers of mites used and then reinfested with newly collected adult females. Significantly more eggs were produced on lightly injured leaves than on moderately and severely injured ones, but there was no significant difference in the number of living mites on the leaves ; the number of eggs per mite was not correlated with population density, but decreased as the amount of feeding injury increased. These results were confirmed by further tests with orange leaves infested with 5, 10, 15, 20, 25 and 30 mites, on which there was no apparent difference in egg production during the first three days, before appreciable injury to the leaves had occurred, indicating that within the density ranges used, the number of mites had no immediate influence on oviposition. When each leaf was reinfested with adult females, there was significant difference in egg production between leaves that had been injured by 5–10, 15–20 and 20–25 mites feeding for five days, a slight increase in mortality associated with feeding injury, and a decrease in the ratio of eggs to mites as feeding injury increased. There was no significant difference in the numbers of living mites or eggs produced on the uninjured parts of lemon leaves that had been fed on by 15 mites for 5 days and on uninjured leaves, showing that the reduction in egg production and longevity was not due to any toxic condition transmissible from one portion of the leaf to another. The numbers of eggs produced on young leaves and on those of medium age were significantly greater than on old leaves, and feeding injury influenced egg production to a much greater extent on flush-growth leaves than on those of medium age, egg production being significantly lower on young leaves injured by 10–20 mites than on uninjured ones and not affected by similar injury to leaves of medium age.

Flanders (S. E.). **Propagation of Black Scale on Potato Sprouts.**—*J. econ. Ent.* **35** no. 5 pp. 687–689, 2 figs., 3 refs. Menasha, Wis., 1942.

An account is given of the technique by which *Saissetia oleae*, Bern., was bred in the laboratory in California for the propagation of the parasites introduced against it from South America [*cf. R.A.E.*, A **28** 374] and Africa [*cf.* **29** 386]. Those from Africa that became established [*cf. loc. cit.*] included *Coccophagus cowperi*, Gir. The Coccid was reared on potato sprouts [*cf.* **9** 340], which should be green, nearly leafless, upright, stocky and tough-fibred for maximum

scale production, and the precautions to be taken in breeding the different parasites are described. Each of the species normally reproducing in *S. oleae* is restricted in oviposition and development to host individuals of a certain range in size, the range varying from very narrow in the case of *Coccophagus ochraceus*, How., to very wide in that of *C. trifasciatus*, Comp. The Coccid is attacked by a succession of parasites in California. *Scutellista cyanea*, Motsch., attacks the eggs, *C. ochraceus* the late first instar, *Metaphycus helvolus*, Comp., the second instar and *M. lounsburyi*, How., the third instar (including the adult stage). The degree to which it is advisable to infest the sprouts with the Coccid depends on the requirements of the parasite to be propagated, since sprouts can be infested more heavily if the scales are to be parasitised at an early stage. The growing scales produce large quantities of honeydew, which they eject over their surroundings, and this must be washed off the sprouts with a coarse spray of water at low pressure until parasitism has occurred, to keep the scales from being smothered.

FLANDERS (S. E.). *Metaphycus helvolus*, **an Encyrtid Parasite of the Black Scale.**—*J. econ. Ent.* **35** no. 5 pp. 690–698, 2 figs., 7 refs. Menasha, Wis., 1942.

A detailed account is given of the bionomics of *Metaphycus helvolus*, Comp., which has given excellent control of *Saissetia oleae*, Bern., on *Citrus* in California [*cf. R.A.E.*, A **31** 90]. This Aphelinid was introduced in 1937 [*cf.* **28** 533; **29** 386] from South Africa, where it appears to be of little importance, probably owing to the activities of the Argentine ant [*Iridomyrmex humilis*, Mayr]. It has been observed to reproduce on several other species of Lecaniine Coccids, including *Saissetia nigra*, Nietn., *Lecanium corni*, Bch., *Coccus pseudomagnoliarum*, Kuw., and *C. hesperidum*, L., and is said to have controlled heavy infestations of the first on native vegetation near Los Angeles. It is endoparasitic and usually solitary, though in one case three individuals were reared from a single host. In the field in July, August and September, the life-cycle lasts 15 days, and in the insectary at a temperature of approximately 82°F., the egg stage lasted 3 days, the first three instars 2 days, the fourth instar, including the prepupal period, 2 days, and the pupal period 6. Unfertilised eggs produce males.

The superiority of *M. helvolus* to other parasites, such as *Coccophagus trifasciatus*, Comp., and *M. lounsburyi*, How., in the control of *S. oleae* in California is due to a number of factors. *C. trifasciatus* requires the presence of other insects for the development of males, which are ecto-hyperparasites [*cf.* **24** 664], the life of the individual parasite is very short and its searching power is limited. *M. lounsburyi* is not completely effective, because it brings about a uniformity in the condition of development of the scale, and the females do not then survive until scales of the next generation are large enough for oviposition. It is also more susceptible to attack by hyperparasites than the other two species, because of its large size, gregarious habit and longer developmental period. Although *C. trifasciatus* and *M. lounsburyi* can reproduce more effectively in the presence of ants than *M. helvolus*, they are less effective at low host population levels. The developmental period of *M. helvolus* is shorter than that of the other species, and the adult female lives longer and oviposits over a much longer period. Also it deposits only one egg in each host individual and none of the parasitised scales produce offspring. Its successful host searching is assured by the long period of host vulnerability during the second and early third stages of development. When the host is scarce, the parasite may destroy more scales by adult feeding than by oviposition.

Insecticides tend to decrease the effectiveness of *M. helvolus*, directly, by destroying the female adults at a time when hosts containing the immature parasites are scarce, and indirectly by bringing about an even-hatch condition

of the host generations, so that there is a lack of food for the parasites. Insecticides for the control of other pests should be applied when immature stages of *M. helvolus* in the scale are most numerous ; sulphur has been shown to be lethal to the adults.

Cox (J. A.). **Effect of dormant Sprays on Parasites of the San Jose and Terrapin Scales.**—*J. econ. Ent.* **35** no. 5 pp. 698–701, 1 fig., 3 refs. Menasha, Wis., 1942.

Since it is a general practice to make annual applications of dormant sprays to commercial orchards, laboratory tests were begun in 1937 to determine the effect of these sprays on the parasites of *Aspidiotus perniciosus*, Comst., and *Lecanium nigrofasciatum*, Perg., in Virginia. In 1937, parasites of seven species emerged from *Lecanium* on unsprayed hawthorn twigs and none from twigs sprayed with petroleum oil, and in 1938, 1940 and 1941, no parasites emerged from *A. perniciosus* on apple twigs or from *L. nigrofasciatum* on hawthorn and peach twigs that were sprayed in March with petroleum oil (alone or with supplementary insecticides) or lime-sulphur, whereas many did so from unsprayed material. In 1939, a few parasites emerged from some sprayed scales, possibly owing to poor coverage or the failure of the sprays to kill some of the advanced stages. The parasites obtained in the four years were *Prospaltella perniciosi*, Tower, *P. diaspidicola*, Silv., *Physcus varicornis*, How., *Marietta carnesi*, How., *Anagrus epos*, Gir., and *Aphytis mytilaspidis*, LeB., from *Aspidiotus*, and *Coccophagus fuscipes*, How., *C. lycimnia*, Wlk., *P. varicornis*, *Chiloneurinus microphagus*, Mayr, *Thysanus pulchra*, Gir., *M. mexicana*, How., *Tetrastichus blepyri*, Ashm., *Aphycus stomachosus*, Gir., *Aphycus* sp. and *Asteropaeus* sp. (near *A. primus*, How.) from *Lecanium*. Several individuals of *Prospaltella perniciosi* emerged from *Aspidiotus* on twigs collected in 1939 from a heavily infested orchard before spraying with a 4 per cent. petroleum oil, but none from scales collected after spraying. In 1941, 41 per cent. of *Aspidiotus* and 40 per cent. of *Lecanium* on unsprayed twigs were parasitised.

Linsley (E. G.). **A further Note on Wood-boring by the Drugstore Beetle.**—*J. econ. Ent.* **35** no. 5 p. 701. Menasha, Wis., 1942.

The author records an additional instance of wood-boring by *Sitodrepa* (*Stegobium*) *panicea*, L. [*cf. R.A.E.*, A **31** 112], adults reared from larvae that bored extensively in thin wooden forms in a private house in San Francisco in May 1942 being identified as this Anobiid ; the pellets of wood that filled the burrows were similar to those of the California death watch beetle, *Hadrobregmus gibbicollis*, Lec.

Scott, jr. (D. B.) & Karr (E. H.). **The Influence of Insecticides added to Soils on Growth and Yield of certain Plants.**—*J. econ. Ent.* **35** no. 5 pp. 702–708, 4 figs., 17 refs. Menasha, Wis., 1942.

To obtain information regarding the effect on plant growth of accumulated quantities of the chemicals used for the control of insect pests on agricultural crops, investigations were carried out in Washington in 1940 with a range of concentrations of insecticides in soil generally higher than those found in the field, which depend on the climate, soil texture and chemical composition, and frequency of application over a period of years. Seeds of bush lima beans and bell pepper [*Capsicum*], representing leguminous and solanaceous crops, respectively, were planted in boxes of untreated clay loam and sandy loam and in the same soils mixed with natural cryolite, standard lead arsenate and calcium arsenate to contain equivalents of 500, 1,500 and 3,000 lb. per foot-acre. The maximum growth of the plants showed that natural cryolite, even at high

concentrations in the soil, caused no appreciable visible injury in clay soil and only slight injury in sandy soil, whereas the two arsenates were very toxic; lima beans did not germinate in any of the arsenic-treated soils except the clay loam treated with 500 lb. per foot-acre. The mean yields for the season showed that natural cryolite in the soil had little significant effect on the yield of either plant, compared with very marked reductions caused by the arsenates. The extent of root development was closely correlated with the plant growth above ground and the yield.

Analysis of soil samples for arsenic trioxide and fluorine showed that the soluble fluorine in the soil, derived from the addition of natural cryolite, was apparently converted to less soluble forms during the experiment, especially in clay soil, whereas the percentage of soluble arsenic was not appreciably lower after the same period of time.

PYENSON (L.). **Three Curculionid Pests of the Oiticica Nut.**—*J. econ. Ent.* **35** no. 5 pp. 715–718, 2 figs., 4 refs. Menasha, Wis., 1942.

Serious damage to the fruits of *Licania rigida*, which grows wild in river valleys in north-eastern Brazil, is caused by the larvae of *Conotrachelus licaniae*, Mshl., and two undetermined and probably undescribed species of the same genus, which greatly reduce the oil content of the seeds by their feeding and also cause premature dropping [*cf. R.A.E.*, A **26** 115]. The adults of all three are briefly described. Approximately 75 per cent. of the fruits in a grove of about 100 trees in Parahyba were found to be infested, chiefly by *C. licaniae*, and there were larvae and pupae 1–1½ ins. deep in the soil near fallen fruits. Mature larvae taken from fruits collected in January and February and placed in dry soil failed to pupate, but those placed in moist soil pupated in 10–15 days and transformed to adults 5–7 days later; the adults remained in the soil for some time, so that the total period spent in it was 20–30 days. All larvae left fruits placed in moist soil within a month, whereas none emerged during this time from others in dry soil, but when the fruits from dry soil were transferred to damp soil, larvae began to emerge from them within a week. Some larvae did not emerge from fruits placed over damp soil for more than three months, and others underwent a diapause in damp soil for three months or more. Since living larvae, which later completed development, were found in fruits that were kept in a dry place for 6–8 months, it is evident that they can continue to feed in them for long periods until favourable conditions develop. Adults fed on fruits for 15 days after emergence lived for another two months, with only a little water supplied occasionally. The insects probably survive during March–September, when there is no fruit on the trees, as larvae in fallen fruits or in the soil and as adults. No parasites were found.

To control the weevils, it is recommended that ripened fruits should be picked about twice a week, and the oil should be extracted as soon as possible. No fruits should be left on the ground after harvesting, and those that drop prematurely should be raked up frequently and destroyed.

LANGE jr. (W. H.). **Certain Plume Moths of economic Importance in California.**—*J. econ. Ent.* **35** no. 5 pp. 718–724, 6 figs., 3 refs. Menasha, Wis., 1942.

In this paper, the author has united available information on the five species of *Platyptilia* that cause economic damage in California, four to agriculturally grown plants and one to plants of importance as sources of nectar for honey bees, and gives keys to the larvae and adults. An account of the bionomics and control of the artichoke plume moth, *P. carduidactyla*, Ril., which is the most important, has already been noticed [*cf. R.A.E.*, A **30** 553]. *P. antirrhina*, Lange, has recently become a serious pest of snapdragons [*Antirrhinum*] in

greenhouses. The larvae mine the leaves during the first two instars and later burrow in the stems, buds or green seed vessels or feed externally among the terminal leaves or buds and the developing flowers. There appear to be three overlapping generations in the year under outdoor conditions in central California, and no parasites of the larvae have been found. The plants should be protected by screening, and exposed larvae and adults were controlled experimentally by a spray containing pyrethrum powder or extract (0·004–0·005 per cent. pyrethrins) with 1–2 per cent. light-medium summer oil (at least 92 per cent. unsulphonatable residue) and 4 oz. blood albumin per 100 U.S. gals. as a wetting agent ; nicotine sulphate, rotenone, lead arsenate and cryolite were ineffective, and light-traps did not give control of the adults. The economic food-plants of *P. williamsi*, Grinnell, are globe artichoke, chrysanthemum, Michaelmas daisy and calendula [*cf.* **30** 554]. *P. fuscicornis*, Zell., which is widely distributed in California and is known to occur in the five States immediately to the east of it, is often a serious competitor to honey bees, as the larvae tunnel inside the buds of a number of plants and destroy the developing flower parts. On *Salvia spathacea*, which is the preferred food-plant, the larvae fed externally among the interfolded leaves of the terminal shoot when the plants were small and bored inside the bud and flower structures when the flower stalks appeared. Three generations and possibly a partial fourth occur on this plant. The larvae were parasitised by an undetermined Ichneumonid of the genus *Posocentrus*, and the spider, *Hesperauximus sternitzkii*, Gertsch, was predacious on them. *Platyptilia pica*, Wlsm., which has been erroneously recorded in North America as the European *P. acanthodactyla*, Hb. [**10** 470 ; **27** 133], is of little economic importance, but the larvae of certain races or subspecies of it occasionally feed on cultivated *Antirrhinum* and geranium (*Pelargonium* spp.) and may be confused with those of *P. antirrhina* or other Lepidoptera. The larvae are often effectively parasitised by the Braconid, *Apanteles insignis*, Mues.

Fritz (R. F.) & Vickers (W. A.). **Damage to Highways by the Mound-building Prairie Ant.**—*J. econ. Ent.* **35** no. 5 pp. 725–727, 1 fig., 3 refs. Menasha, Wis., 1942.

*Pogonomyrmex occidentalis*, Cress., occurs throughout central and western Kansas, and the mounds that it constructs can be found in many crop and plant environments, but are more common along the roads than elsewhere, probably because the vegetation is scraped away when the road is built and the ground rarely disturbed afterwards and because food, in the form of grain from passing trucks and weed seeds, is abundant. The ants do considerable damage to the roads by clearing the shoulders of soil-binding vegetation round their nests, as a result of which soil erosion occurs during heavy rains, and by building nests beneath the edge of the road surface, weakening the highway base and causing the surface to sink or to crack and break up ; they have also destroyed grasses, shrubs and trees planted beside the roads for ornamental purposes. They can be killed by evaporating 1–3 oz. carbon bisulphide under a galvanised tub inverted over the mound, but better results were given on highways by introducing the fumigant into the centre of the nest with a specially converted fire extinguisher, or by pouring it into holes in the mound, which was then covered with several folds of newspaper and soil. Nests in which ants survive should be treated again after two weeks.

[**Papers on Systematic Entomology.**]—*J. econ. Ent.* **35** no. 5 pp. 732–761, 19 refs. Menasha, Wis., 1942.

The following comprise papers read at two recent Taxonomy Symposia in California : The Needs of Systematic Entomology, by G. F. Ferris (pp. 732–738), in which the difficulties under which systematic entomology has been carried

out in the past are discussed and the necessity for a uniformly high standard of work with economic insects, improved training of systematists, better facilities for publishing results and the provision of paid positions in which adequate research work can be done is emphasised ; The Significance of Taxonomy in the general Field of Economic Entomology, by E. O. Essig (pp. 739–743), which points out the divergence between taxonomy and economic entomology that has developed in the last few years, owing to increased specialisation, and the need for more co-operation between workers in different fields and for better equipment and opportunties for systematic work ; The Relation of Taxonomy to Biological Control, by C. P. Clausen (pp. 744–748), in which the importance of correctly identifying the host species before attempting to introduce natural enemies is illustrated by numerous examples ; The Significance of Economic Entomology in the Field of Insect Taxonomy, by T. H. Frison (pp. 749–752), which is an account of the ways in which economic entomology has benefited insect taxonomy, by making available the advanced methods and techniques that it has developed, by revealing the soundness or otherwise of taxonomic studies, which are based primarily on the more obvious morphological likenesses and differences, and by providing funds to employ personnel and carry on such studies ; Fundamental taxonomic Problems in Quarantine and Nursery Inspection, by C. F. W. Muesebeck (pp. 753–758), which deals with the importance of adequate descriptions of species, availability of type specimens and abundant material with associated biological and distributional data, particularly in the identification of quarantine interceptions, which may come from any part of the world, including regions of which the insect fauna is relatively poorly known, and the need for caution in identifying insects quickly from few or imperfect specimens and from the immature stages and for an understanding of the correlation of structure and habits in insects ; and The present Status of entomological Nomenclature, by E. G. Linsley (pp. 758–761), in which the development of the International Rules of Zoological Nomenclature and attempts to modify them for use in entomology are described, and it is suggested that until international action is again possible, American entomologists should formulate and adopt their own rules, based on the present code but extending it in some respects.

[**Papers on Plant Quarantine and Inspection.**]—*J. econ. Ent.* **35** no. 5 pp. 765–779. Menasha, Wis., 1942.

These papers comprise the following : Recent Quarantine Adjustments giving increased Consideration to biological Findings, by T. L. Aamodt and A. G. Ruggles (pp. 765–770) ; What regulatory Officials should do to simplify and coordinate the Plant Quarantine and regulatory Structure of the United States, by C. J. Drake (pp. 771–774) ; Regulatory Pest Control in California, by G. E. Woodhams (pp. 775–777) ; Why California Agricultural Commissioners are State Plant Quarantine Officers, by H. J. Ryan (pp. 777–778) ; and California Intercounty Inspection Problems, by G. B. Laing (pp. 778–779).

Anderson (L. D.) & Walker (H. G.). **Control of Flea Beetles on Potatoes at New Church, Virginia, in 1941.**—*J. econ. Ent.* **35** no. 5 pp. 780–781, 2 refs. Menasha, Wis., 1942.

In experiments against *Epitrix cucumeris*, Harr., on potato in 1941, a spray of calcium arsenate and Bordeaux mixture [*cf. R.A.E.*, A **29** 503] resulted in higher yields and less feeding injury than Bordeaux containing derris or Syntone (a concentrated activated rotenone emulsion containing a stabiliser) ; and all sprays containing Bordeaux gave higher yields than a proprietary mixture of Paris green and calcium arsenate with a neutral copper fungicide and much higher yields than a mixture of yellow cuprous oxide and talc with calcium arsenate or with derris. The sprays were applied on 22nd and 31st May and

11th, 19th and 27th June, and they began to lose their effectiveness within 7–10 days of the last treatment ; almost all the plants were dead when the potatoes were dug on 22nd July. The sprays of derris or Syntone and Bordeaux gave a high initial kill, but resulted in lower yields when applied instead of the spray of calcium arsenate and Bordeaux at the time of greatest infestation ; they caused no injury to the plants. Plants sprayed with yellow cuprous oxide lost their foliage almost as soon as the untreated plants and nearly 2–3 weeks earlier than those sprayed with Bordeaux. Those sprayed with the proprietary mixture retained their foliage nearly as long as those treated with Bordeaux, but had more feeding injury. In tests on the resistance of varieties, carried out during the spring seasons of 1940 and 1941, two later maturing varieties had significantly fewer feeding scars per sq. in. leaf surface than an early variety, and gave significantly higher yields when all the varieties were allowed to mature, but when they were dug at or before the time of maturing of the early one, this gave yields as high as the others or higher.

Siegler (E. H.) & Bowen (C. V.). **Toxicity of certain Acid Amides and their N-substituted Derivatives to Codling Moth Larvae.**—*J. econ. Ent.* **35** no. 5 pp. 781–784, 3 refs. Menasha, Wis., 1942.

Siegler (E. H.) & Haller (H. L.). **Toxicity of Sulfanilamide and related Compounds to the Codling Moth Larvae.**—*T. c.* p. 784, 2 refs.

In these two papers are given the results of tests by the apple plug method [*cf. R.A.E.*, A **23** 174] of the toxicity to larvae of the codling moth [*Cydia pomonella*, L.] of 79 and 40 compounds, respectively. The best were far less effective than lead arsenate, and it is concluded that none of them shows promise.

Denning (J. A.). **The present Status of *Parlatoria chinensis* Marlatt in St. Louis.**—*J. econ. Ent.* **35** no. 5 pp. 784–785. Menasha, Wis., 1942.

An account is given of the extent and severity of infestation by *Parlatoria chinensis*, Marl., in the autumn of 1940 in St. Louis, Missouri, where it was first observed in April 1940 [*cf. R.A.E.*, A **30** 426], and of its increase by the autumn of the following year. The food-plants included more than 85 species in 42 genera [*cf.* **30** 172] ; apple, peach, pear, cherry, *Althaea*, lilac, privet [*Ligustrum*] and currant were among those most commonly infested. Fertilised females overwintered and oviposited in May or June. The crawlers hatched in about ten days and matured in about six weeks. The second generation appeared about 15th July and a partial third at the beginning of November. Dormant oils did not control the scale, and summer oils, though more promising, have not yet given satisfactory results.

Carlson (F. W.). **Refrigeration Test of transforming Codling Moth Larvae.**—*J. econ. Ent.* **35** no. 5 p. 787. Menasha, Wis., 1942.

As larvae of the overwintering generation of the codling moth [*Cydia pomonella*, L.] can be kept in cold storage until long after their normal emergence period without serious loss of vitality, experiments were carried out in Washington in 1941–42 to determine whether larvae that would normally give rise to adults without overwintering could be similarly stored. Larvae of the first generation, collected from burlap bands on apple trees on 11th July and allowed to make cocoons, were placed in a refrigerator at a constant temperature of 40°F. and a humidity of 40 per cent. on 14th July, and groups were removed after various periods. The percentages of larvae that transformed to adults in these groups and (in brackets) the number of days refrigeration were 67·1 (14), 54·8 (28), 45·8 (42), 27·9 (56), 46 (86), 22·2 (117), 1·4 (147), 0·6 (178)

and 0·7 (237). The mortality of larvae collected at the same time and kept at normal outdoor temperatures was only 8 per cent. The small numbers that emerged from the last three groups, which were removed from the refrigerator during December, January and March, probably consisted chiefly of individuals that would have hibernated, since a small proportion of the first generation normally does not emerge until the following year.

De Bach (P.). **The Introduction and Recovery of *Trissolcus murgantiae* Ashm. in California.**—*J. econ. Ent.* **35** no. 5 p. 787, 1 ref. Menasha, Wis., 1942.

*Trissolcus murgantiae*, Ashm., a Scelionid egg parasite of the harlequin bug [*Murgantia histrionica*, Hahn], was introduced into California from Mississippi in the autumn of 1940, and 80 individuals were liberated in the coastal area in November 1941 on plants of wild mustard (*Brassica campestris*) infested by the Pentatomid. A further 500 were liberated at another place in this area on the same plant in January and February 1942, and 200 more at a third on bladder pod (*Isomeris arborea*), which is infested with the bug throughout the season, in May. The parasite was recovered from the last liberation in July, 8 adults of *Trissolcus* and 583 of the indigenous parasite, *Ooencyrtus johnsoni*, How., being reared from 506 of the 617 eggs of *Murgantia* that were collected. Recovery from the earlier liberations was not attempted as the plants in the original wild mustard stands had died out. Although permanent establishment of *T. murgantiae* is not yet certain, it is probable, owing to the constant and abundant supply of hosts on bladder pod.

Chamberlin (F. S.) & Madden (A. H.). **Mixing poisoned Bait for the Tobacco Budworm.**—*J. econ. Ent.* **35** no. 5 pp. 789–790. Menasha, Wis., 1942.

In view of the possibility that the known efficiency of the bait of lead arsenate and maize meal (1 : 75) applied to tobacco buds for the control of *Heliothis virescens*, F., depends partly on its thorough mixing by methanical equipment, it was mixed for experiment in a power-operated mechanical mixer, a home-made barrel mixer, by hand in a wash tub or bucket, by the box and hoe method, and in a hand-operated mechanical mixer. When applied by hand to the buds in a field of cigar-binder tobacco in Florida twice a week for eight weeks in the 1940 growing season, each mixture reduced the commercial loss due to the Noctuid from approximately 72 per cent. to less than 1 per cent. and chemical analysis of samples showed that the baits were uniform. It is therefore concluded that all the mixing methods tested are satisfactory.

Shands (W. A.), Bronson (T. E.) & Simpson (G. W.). ***Brassica campestris* L. and *Raphanus raphanistrum* L. as breeding Hosts of the Green Peach Aphid.**—*J. econ. Ent.* **35** no. 5 pp. 791–792. Menasha, Wis., 1942.

Field observations in north-eastern Maine during the latter half of July 1941 showed that large numbers of *Myzus persicae*, Sulz., and *Aphis rhamni*, Boy. (*abbreviata*, Patch) were developing on the leaves of two weeds, *Brassica campestris* and *Raphanus raphanistrum*, which were very abundant, and experiments were therefore undertaken to determine the probable importance of these plants as sources of winged Aphids of both species, which commonly migrate to potatoes during August and September. On 28th July, approximately equal numbers of young plants, plants in the early flowering stage and mature plants of each species, growing in the field, were caged, and half of them were artificially infested with an average of 4·4 adults and 33·6 nymphs of *M. persicae* per plant and the others with an average of 8·3 adults and 82·4 nymphs

of *A. rhamni*, in addition to the natural infestation present. All winged Aphids were removed at intervals of 4–10 days from 8th August to 24th September, identified and counted. The average numbers of alates of *M. persicae* recovered per plant from the two weeds were 857, 628 and 143 on mature, early-flowering and young plants. The differences in numbers on individual plants were too great for significant differences to be shown between plants of the two species or those that were or were not infested artificially. Few winged individuals of *A. rhamni* were found, possibly because the period during which they are produced on these weeds was over by the end of July. Relatively small numbers of *Macrosiphum solanifolii*, Ashm., *Rhopalosiphum pseudobrassicae*, Davis, and *Brevicoryne brassicae*, L., were also taken on the plants. In view of the large numbers of alates of *Myzus persicae* that developed, it is concluded that these two weeds are potentially important sources of Aphid infestation of potato.

CARTER (R. H.). **The Nature of "Cobalt" once recommended for Control of the Tobacco Hornworm.**—*J. econ. Ent.* **35** no. 5 pp. 792–793, 8 refs. Menasha, Wis., 1942.

Since metallic cobalt and its salts with the common acids are not recognised as insect poisons and several that were tried against adults of *Protoparce sexta*, Joh., were not toxic, the author discusses the possible identity of the insecticide known as "cobalt" that was formerly used with sugar solution and applied in the corollas of jimson-weed (*Datura stramonium*) as a bait for these moths in the United States. References in the literature are briefly reviewed, and chemical analyses of four samples of materials formerly sold for this purpose, which were labelled "cobalt poison" or "black cobalt" are given. It was found that arsenic was the toxic element common to all the samples; manganese was present in two and cobalt in only one.

GRAHAM (O. H.). **The median lethal Dose of Calcium Arsenate for the Honeybee.**—*J. econ. Ent.* **35** no. 5 pp. 793–794, 1 fig., 1 ref. Menasha, Wis., 1942.

In view of high mortality of honey bees in Texas due to the increase in the use of calcium arsenate for the control of cotton pests, laboratory tests were carried out by a method described to determine its toxicity to the bees. Individuals were allowed to feed for varying times on a calcium arsenate containing 42·99 per cent. total $As_2O_5$ and 7·3 per cent. water-soluble $As_2O_5$, mixed with queen candy, and the quantities consumed by 145 bees were measured. Analysis of the results by the method of Bliss [*R.A.E.*, A **27** 66] indicated that the median lethal dose was 0·039 mg. calcium arsenate per gm. body weight.

WEIMER (J. L.) & BISSELL (T. L.). **The Vetch Bruchid in Georgia.**—*J. econ. Ent.* **35** no. 5 p. 794, 2 refs. Menasha, Wis., 1942.

Although several species and varieties of vetch (*Vicia*) have been grown at Experiment, Georgia, every year since 1936, and the seed has been kept each year without fumigation, no example of *Bruchus brachialis*, Fhs., which was recorded from Georgia in 1936 [*R.A.E.*, A **25** 36], was found until June 1942, when many adults appeared in the newly harvested seed of *Vicia villosa* and *V. dasycarpa*, the percentage infestation of the seeds ranging from 1·5 to 11·5. No Bruchids were found in seeds of *V. sativa*, *V. monanthos*, *V. grandiflora* or *V. atropurpurea* [*cf.* **30** 311].

Imle (E. P.) & Hartzell (A.). **Some Insect Pests of Lilies.**—*Amer. Lily Yearb. 1942* repr. [6] pp., 4 figs., 6 refs. 1942.

Notes based partly on the literature are given on the habits of insects that infest lilies (*Lilium*) in the United States, and some of them are briefly described. Observations in 1937–41 showed that the commonest Aphids on lilies are *Aphis gossypii*, Glov., *Macrosiphum lilii*, Monell, and *Myzus circumflexus*, Buckt. *A. gossypii* is abundant on lilies in greenhouses and gardens in New York City and usually appears in the first half of May. It feeds mostly on the new growth, including the buds, and transmits the virus [*Marmor cucumeris* var. *lilium* of Holmes] that causes mosaic disease of lilies. *Macrosiphum lilii*, which is more injurious than *A. gossypii* in some districts and attacks lily plants at all stages of their growth, is recorded from New York and Massachusetts and from 37 species and hybrids of the genus *Lilium*; it usually attacks the undersides of the older leaves, but when abundant feeds on all the aerial parts of the plant, except the harder portions of the stem. This Aphid is a serious pest in greenhouses only during the summer, when it migrates from infested outdoor plantings. It migrated naturally from lilies to tulips and roses in a greenhouse and multiplied slowly on them, but has not been observed on other plants. *Myzus circumflexus* is commoner in greenhouses and cold frames, where it injures lily seedlings, than in the open. Other Aphids found on lilies during some part of the growing season includes *Macrosiphum solanifolii*, Ashm., and *M. solani*, Kalt. (*Myzus pseudosolani*, Theo.).

These Aphids can be controlled by sprays or dusts containing nicotine in the open and by fumigation with nicotine in the greenhouse; a 3 per cent. nicotine dust is effective but leaves an unsightly residue on the foliage, and fumigation is less successful against *A. gossypii*, since this Aphid infests the closely folded leaves of the growing tip. Nicotine sulphate (1 : 300) in water or Bordeaux mixture has given good control.

*Ctenothrips bridwelli*, Franklin, has recently been observed on lilies in Vermont and New York, and completely spoiled one planting in 1939–40. This thrips occurs commonly on skunk cabbage (*Symplocarpus foetidus*), *Trillium* and other succulent plants in wooded areas and has been found to breed on *Polygonatum*. *Liothrips vaneeckei*, Priesn., which attacks the bulbs, occurs on the west coast [*cf. R.A.E.*, A **28** 345]. The stems of lilies are tunnelled by the larvae of *Papaipema nebris*, Gn., and are occasionally infested by the Cecidomyiid, *Neolasioptera hibisci*, Felt [*cf.* **28** 22]; the former seldom destroys more than a few plants in one place, but the latter sometimes causes serious losses.

Blanton (F. S.) & Haasis (F. A.). **Insect Transmission of the Virus causing Narcissus Mosaic.**—*J. agric. Res.* **65** no. 9 pp. 413–419, 14 refs. Washington, D.C., 1942.

The authors have already reported experimental transmission of narcissus mosaic in New York by seven Aphids [*R.A.E.*, A **27** 652; **29** 415], of which *Macrosiphum solanifolii*, Ashm., *M. onobrychis*, Boy. (*pisi*, Kalt.), *Aphis rumicis*, L., and *Anuraphis roseus*, Baker, occur on narcissus and *M. rosae*, L., *M. solani*, Kalt. (*Myzus convolvuli*, Kalt.) and *Myzus cerasi*, F., do not. *Macrosiphum solanifolii* was the only one of these found capable of multiplying on narcissus. They here give details of these experiments, together with the results of negative ones with other insects and mites that occur on narcissus on Long Island. These comprise the Jassids, *Aceratagallia sanguinolenta*, Prov., *Macrosteles divisus*, Uhl., *Draeculacephala mollipes*, Say, and *Dikraneura* sp., the Delphacid, *Stobaera tricarinata*, Say, *Frankliniella fusca*, Hinds, *Thrips tabaci*, Lind., *Bourletiella hortensis*, Fitch, and the mites, *Bryobia*

*praetiosa*, Koch, and *Tarsonemus laticeps*, Halbert. The Aphids, *Macrosiphum taraxaci*, Kalt., *Myzus persicae*, Sulz., and *Brevicoryne brassicae*, L., were also collected on narcissus foliage.

Patch (L. H.), Still (G. W.), Schlosberg (M.) & Bottger (G. T.). **Factors determining the Reduction in Yield of Field Corn by the European Corn Borer.**—*J. agric. Res.* **65** no. 10 pp. 473–482, 1 fig., 5 refs. Washington, D.C., 1942.

The following is substantially the authors' summary of this account of work carried out in Ohio in 1929–34. The degree of reduction in yield of field maize resulting from definite levels of population of *Pyrausta nubilalis*, Hb., was determined by manually infesting plants with various numbers of egg masses. Reduction in yield within fields is shown to be proportional to the number of borers present up to 22 per plant. Within the range from 28 to 85 bushels per acre, the fields that would have produced greater normal yields in the absence of borers had smaller proportions of their crops destroyed by a given number of borers than the fields with lower yields. Data from plantings of the Clarage variety in various localities in north-western Ohio in 1929–33 showed that the rates of yield reduction were 2·68 and 4·86 per cent. per borer per plant when the normal yields were 85 and 28 bushels per acre, respectively. The rates for hybrids were 3·93 and 3·02 per cent. when the normal yields were 105 and 85 bushels. The rate in maize planted on soils differing in type or fertility is probably a direct function of the level of normal yield. In seasons of drought, the damage per borer at given yield levels appears to be increased. The stage of plant development at the time of infestation is an important factor. Plants infested early in their development suffered greater rates of yield reduction, owing to the longer duration of borer feeding before the critical period of ear production and the consequent weaker condition of the plants, and to the larger average size of the borers during the period of ear production. The average normal yield of 85 bushels per acre over a four-year period, for maize planted on the average date 9th May, was reduced 2·85 per cent. per borer per plant as compared with 4·71 per cent. for the same hybrids giving about the same average yield, but planted 23 days later. Attempts were made, without much success, to find hybrids that could maintain their yields at a given level of infestation to a greater degree than would other hybrids of equal yielding ability.

**Fifty-Fourth Annual Report of the South Carolina Experiment Station of Clemson Agricultural College.**—182 pp., 41 figs., 3 refs. Clemson, S.C., 1941. [Recd. 1943.]

This report contains accounts of work on insect pests in South Carolina during the year ending 30th June 1941. O. L. Cartwright (p. 68) gives figures to show that parasites of the oriental fruit moth [*Cydia molesta*, Busck] on peach were scarce and less effective in 1941, probably owing to very hot dry weather, than at any time during the previous ten years [*cf. R.A.E.*, A **30** 41].

F. Sherman, Cartwright, W. M. Upholt and J. G. Watts (pp. 68–70) record further work on the control of the tomato fruit worm [*Heliothis armigera*, Hb.] by means of baits and dusts [*cf.* **30** 42]. Baits of maize meal containing natural or synthetic cryolite, calcium arsenate or air-floating Paris green at concentrations of 5, 10, and 20 per cent., or phenothiazine at 10 per cent., all gave an appreciable measure of control, with little difference between the different insecticides or concentrations. Baits containing 10 per cent. magnesium arsenate or barium fluosilicate were less effective, and those containing 2 per cent. dinitro-ortho-cyclohexylphenol or dinitro-ortho-cresol were very injurious to the tomato plants. Of dusts of natural or synthetic cryolite, calcium arsenate, basic copper arsenate and air-floating Paris green diluted in a mixture of

10 per cent. cottonseed meal and kaolin, and pyrethrum in Pyrax [pyrophyllite], only those with the highest concentration of synthetic cryolite, basic copper arsenate and Paris green (90, 90 and 50 per cent., respectively) were as effective as the baits, which confirms previous evidence that highly-diluted dusts are practically valueless against *Heliothis* on tomato.

N. Allen and H. N. Pollard (pp. 123–127) give an account of experiments to develop an effective measure against larvae of *Cotinis nitida*, L., which are injurious in tobacco plant-beds, since the bait usually applied, comprising 1 lb. Paris green and 25 lb. wheat bran distributed at the rate of 12 lb. (dry weight) per 100 sq. yds. [**14** 487], has given very variable results. Preliminary plant-bed tests in 1940 and greenhouse tests in January 1941, in which baits were applied, usually at a rate of 18 lb. wet weight per 100 sq. yds., to boxes of sand containing larvae indicated that the standard bait did not give satisfactory control. The greenhouse tests also showed that Paris green at a concentration of 1 lb. in 25 lb. carrier is lethal to the larvae, and that the latter are attracted to syrup, sugar and a commercially-prepared white syrup, and to a less extent, to blackstrap molasses, mixed with maize meal. The addition to a bait consisting of 1 lb. Paris green in 25 lb. maize meal of syrup at the rate of 5 U.S. quarts in 1 bushel meal gave the most consistently satisfactory results, and sugar-cane syrup was slightly more effective than maize-cane syrup. Lead arsenate and tartar emetic were of little value in baits.

In further work, the most effective baits were compared in plant-beds containing about 5,000 larvae per 100 sq. yds. Soil treatment with solutions of 1 or 2 oz. mercuric chloride in 30 U.S. gals. water applied at the rate of 200 U.S. gals. per 100 sq. yds. was also tested and proved ineffective. Unexpectedly, the standard Paris-green bait was more effective than the one containing maize meal and syrup, but it appeared probable that the wheat bran used contained wheat middlings. The effect of various wheat products as carriers was therefore tested, and Paris green with wheat middlings, wheat shorts or a mixture of equal parts of either with bran killed twice as many larvae as with bran alone. In further plant-bed tests, a bait containing 1 lb. Paris green and 25 lb. wheat middlings mixed with 2½ U.S. gals. water and applied at the rate of 18 lb., wet weight, per 100 sq. yds. gave varying results, but was generally the most effective wheat-product bait tested, though it destroyed only about two-thirds of the larvae present in five days. Since all the larvae may not come to the surface for several days, the soil should be watered before the bait is set out, as this appears to increase their activity.

Allen and Pollard also describe and figure (pp. 127–130) a unit of adjustable horizontal spray booms with six nozzles for applying insecticides from below, from the side, and from above to plants for flue-cured tobacco at different stages of growth.

EYER (J. R.) & CRAWFORD (R. F.). **Control of Insect Pests and Diseases of New Mexico Crops.**—*Bull. N. Mex. agric. Exp. Sta.* no. 288, 50 pp., 12 figs., 26 refs. State College, N. Mex., 1942.

This bulletin was written with the object of increasing the production of food crops in New Mexico by controlling insect pests and diseases. About half of it deals with the preparation and uses of insecticides and fungicides, and the remainder includes brief surveys of the principal kinds of pests, showing the applicability of the various control measures against them, and programmes for the treatment of the individual crops.

**Service and Regulatory Announcements, July-September 1942.**—*S.R.A., B.E.P.Q.* no. 152 pp. 49–70. Washington, D.C., U.S. Dep. Agric., 1942.

Announcements relating to Quarantine no. 48 against the Japanese beetle [*Popillia japonica*, Newm.] include Administrative Instructions (B.E.P.Q. 499

supplement no. 6) authorising the treatment with ethylene dichloride emulsion of plants after digging between 1st October and 1st June. Plants with root masses or soil balls not exceeding 10 ins. in diameter at the narrowest dimension may be treated either bare, wrapped in material that will not hinder penetration, or in unglazed clay pots. Emulsible ethylene dichloride is prepared by dissolving 2½ lb. potassium hydroxide (C. P. grade) or commercial caustic potash containing an equivalent weight of potassium hydroxide in 14 lb. ethyl alcohol (190 proof) or completely denatured alcohol (190 proof) and 6 lb. water, adding 17½ lb. oleic acid, stirring intermittently for 10 minutes and, after adding alcohol and water in the ratio given to compensate for loss by evaporation, stirring in 60 lb. commercial ethylene dichloride. The product must have a specific gravity of about 1·070 at 77°F. and contain 60 per cent. ethylene dichloride by weight ; it should be stored in air-tight containers in a cool place at a temperature above 40°F. At low temperatures it separates into layers and must then be warmed to room temperature and stirred before it can be used. Immediately before treating the plants, an emulsion containing 1 per cent. by volume of emulsible ethylene dichloride is prepared by adding water, a little at a time, until a uniform cream-like emulsion is formed and then stirring in the rest of the water to produce a uniform suspension. The plant balls, which must be moist, but not wet, are placed singly or in groups in which the balls are ¼ in. apart in a wire basket or perforated tray on the botton of a tank or trough in a covered, well-ventilated situation. The tank must contain enough emulsion to cover the plant balls and the lower ½ in. of the plant stems ; there is a risk of injury to the plant if more of the stem is covered. The plant balls must remain in the dip for 10 seconds and the temperature of both soil and emulsion at the time of treatment must be not lower than 45 nor higher than 75°F. If necessary, freshly-prepared, diluted emulsion must be added to maintain the prescribed level throughout the treatment, and when the soil and débris in the tank exceeds 2 ins. in depth, the contents must be removed and the tank rinsed and filled with fresh emulsion ; this must in any case be done after the emulsion has been in use for 4 hours. On removal from the dip, balled plants may be allowed to drain into it for 1 or 2 minutes, after which they must be placed in a compact group on a watertight bench or on the watertight floor of a greenhouse, packing shed or other enclosed area, surrounded by wooden walls as high as the plant balls. In the case of potted plants, excess emulsion should be poured from the pot as soon as it is removed from the dip. All plants must remain undisturbed for 48 hours during which their temperature must not fall below 40 nor exceed 80°F. and excessive ventilation must be avoided. A light spray of water applied to the tops of the plants may be beneficial during this period. In experiments, 18 varieties of azaleas and 136 kinds of greenhouse plants, herbaceous perennials, trees and shrubs have been successfully treated.

Administrative Instructions (B.E.P.Q. 499 supplement no. 1 sixth revision) authorise the fumigation against *P. japonica* of plants with bare roots or in pots or soil balls, and of boxed or wrapped plants in packages, none of which exceed 14 ins. in thickness, with methyl bromide by the schedules already noticed [*R.A.E.*, A **30** 174 ; **31** 115] and also at a dosage of 3 lb. per 1,000 cu. ft. for periods of 4 and 4½ hours at temperatures of the soil (or root-spaces of bare stock) and air of at least 46 and 43°F., respectively.

Since recent experiments have shown aqueous solutions of methyl bromide to be effective against *P. japonica* in soil, Administrative Instructions (B.E.P.Q. 499 supplement no. 7) authorise their application under supervision in dry weather between 1st October and 15th May. Soil to be treated in and round cold frames, plunging beds, etc., in the absence of plants must be pulverised and loosened to a depth of at least 1 in. and the surface of wet soil must be tilled and allowed to dry for at least 24 hours before being pulverised. The solution must be applied uniformly by means of a sprinkling can held not more than 6 ins. from the soil surface at the rate of 3 gals. per square yard and at

percentage concentrations (by volume) of 0·15, 0·10 and 0·05 where the minimum temperatures in the top 6-inch layer of soil are 47–56, 57–67 and 68°F. and over, respectively. It must also be applied to a strip of soil 3 ft. wide surrounding the area to be certified except in the case of cold frames, etc., that extend into the soil to a depth of at least 12 ins. After treatment, the soil must not be disturbed for 48 hours. For soil about the roots of growing plants that are to be dug up (and as an alternative treatment for soil in frames, etc.), collars must be used [**18** 355], and the solution applied at concentrations of 0·100, 0·075, 0·050, 0·040, 0·025 and 0·015 per cent. where the minimum temperatures in the top 6-inch layer of soil are 47–51, 52–56, 57–62, 63–67, 68–72 and 73°F. and over, respectively. Soil of any type or in any condition can be treated, provided that there is no standing water and that all the solution enters the soil within 30 minutes. The area to be treated must be freed from weeds and débris and practically level, and the soil in the collar loosened to a depth of 1 in.; a margin of treated soil at least 2 ins. wide must remain when the plants are lifted. Provided that it is kept in a shaded air-tight container, the solution may be used up to 24 hours after preparation; it must be withdrawn from the preparation-drum through a hose extending to the bottom of the measuring vessel, from which it must be poured quickly and without splashing on to the collar area; the soil within this area must then be smoothed so that the surface is uniformly submerged. The plants must be lifted not less than 20 and not more than 48 hours after treatment.

Notice is given of a public hearing to consider the advisability of extending the White-fringed Beetle Quarantine (Quarantine no. 72) [*cf.* **27** 274] to include North Carolina, since white-fringed beetles (species of the subgenus *Graphognathus* of *Pantomorus*) were found at several places there in the summer of 1942. Farm land was infested as well as industrial and residential areas.

Other information in this part includes supplements to plant-quarantine import restrictions already noticed from Jamaica and Peru.

CRAIGHEAD (F. C.). **The Influence of Insects on the Development of Forest Protection and Forest Management.**—*Rep. Smithson. Instn 1941* (Publ. 3665) pp. 367–392, 12 pls., 2 figs., 57 refs. Washington, D.C., 1942.

Some of the insect outbreaks that have occurred in forests in the United States over a period of 50 years are reviewed, the relation of outbreaks and fire risk is briefly discussed, and the organisations set up to deal with problems of forest entomology are described. A survey is given of the methods and results of direct control of bark-beetles and defoliators, and more recent suggestions, in view of the observed preferences of certain insects for trees in certain stages and conditions of growth, that direct control methods should be supplemented and in time replaced by protection through management based on the selective felling of susceptible trees are discussed, with special reference to attack by bark-beetles on ponderosa pine [*Pinus ponderosa*]. Various theories of the factors rendering this species susceptible to attack are reviewed, and a classification of susceptibility, based on the age and vigour of the trees, is described and illustrated [*R.A.E.*, A **25** 416]. A final section contains examples of the application in pine and hardwood stands of silvicultural systems primarily designed to avoid losses from such insects as the gipsy moth [*Lymantria dispar*, L.] [*cf.* **25** 415, etc.], the white pine weevil [*Pissodes strobi*, Peck] [**15** 406], the turpentine borer (*Buprestis apricans*, Hbst.) [**21** 95] and the bronze birch-borer (*Agrilus anxius*, Gory) [**22** 135, etc.], each of which was the dominant factor to be considered in shaping the management of the forest types in which they are active.

Blackman (M. W.). **New Genera and Species of Neotropical Bark Beetles (Coleoptera : Scolytidae).**—*J. Wash. Acad. Sci.* **33** no. 2 pp. 34–38, 6 figs. Menasha, Wis., 1943.

Five new species of Scolytids in two new genera are described. The only one of which the food-plants are known is *Tachyderes floridensis*, which was bred from *Rhacoma crossopetalum* in Florida and rubber (*Hevea brasiliensis*) in Haiti and is also recorded from Texas, Mexico and the Virgin Islands.

Hynes (H. B. N.). **Lepidopterous Pests of Maize in Trinidad.**—*Trop. Agriculture* **19** no. 10 pp. 194–202, 2 graphs, 13 refs. Trinidad, 1942.

An account is given of investigations on the habits of *Laphygma frugiperda*, S. & A., and *Heliothis armigera*, Hb., on maize in Trinidad, carried out between November 1941 and June 1942, to discover why they are normally less serious pests there than in some of the northern islands of the West Indies. It was observed during December, when neither species was present on the crop, that the stems were infested by *Diatraea lineolata*, Wlk., and *D. saccharalis*, F., and they were consequently included in the study, which was made on maize sown in early October and early December, but not on the main crop sown in June. The sampling and breeding techniques are described. There was no serious outbreak of *L. frugiperda* in progress and the larvae were found almost entirely on maize. Only the leaves of young plants were damaged, and the attack ceased as soon as the tassels began to form. Very little permanent injury is caused, though the plants may be killed under outbreak conditions. Females deposit 1,000–4,000 eggs in clusters of up to several hundred on the upper surface of the leaves in or near the " throat " of young plants 1–3 feet high ; the egg, larval and pupal stages lasted 2–3, 14–25 and 8–11 days, respectively, in the laboratory. The larvae first feed on the leaves and then migrate to the young rolled-up leaves in the throat of the plant, where they kill each other until usually only one survives. There is little dispersion of larvae if sufficient food is available. They are destroyed by birds and wasps (*Polistes*) and were parasitised by *Archytas piliventris*, Wulp, another species of the same genus, *Winthemia* sp. and *Eiphosoma* sp. *A. piliventris* was the only one obtained in large numbers, and in November 1941 adults of this Tachinid were reared from 21 of 115 host larvae. It is suggested that it might be of value if introduced into the Lesser Antilles, if it is not already present there ; it was bred from *L. frugiperda* on St. Vincent in 1936.

*H. armigera*, which is a serious pest of maize in many of the Lesser Antilles, is of minor importance in Trinidad. It was not found on cotton there in 1942 and only one individual was found in nearly 35,000 bolls in 1941 ; it caused slight injury to ochro [*Hibiscus esculentus*] and tomatos. Larvae were rare in the October-sown maize, but 55 per cent. of the cobs were attacked in the December-sown crop, which matured during the dry season. Only a few grains at the tip were destroyed, however. The larvae did not damage the leaves. The life-cycle probably lasts 3–4 weeks, and only one generation is passed on each crop. Control is not generally necessary, but it is suggested that maize having long tight-fitting husks should be grown [*cf. R.A.E.*, A **24** 304]. *Sarcophaga lambens*, Wied. (*Sarcodexia sternodontis*, Tns.) was reared from 2 of 64 nearly full-grown larvae, and *Trichogramma minutum*, Ril., which parasitises the eggs of *H. armigera* in the United States, is known to occur in Trinidad as a parasite of other moths.

When the larvae of *Diatraea* were first observed (December 1941), the maize was rapidly drying, and *D. lineolata* appeared to be far commoner than *D. saccharalis*. The eggs of this Pyralid are laid on the leaves. The larvae hatch in 3 days, feed on the leaves and then migrate to the tassel and bore into the stem. The larval stage in growing maize appeared to last 4–6 weeks and the

pupal stage, which is passed in a cell in the stem, about 10 days. In dry stalks in dry weather, the larvae enter a resting stage, in which they do not develop at the usual rate, though they remain active and moult, and differ in coloration from normal larvae. When the October-sown maize was harvested on 1st February, 36·1 per cent. of the dry stalks contained larvae more than three-quarters grown and pupae were rare ; all proved to be *D. lineolata*. Observations during the dry season showed that very few pupae appeared until rain fell at the end of April. Larvae in this stage fed on the pith and moulted several times in the laboratory. When 60 resting larvae taken in the field in April were placed in pairs in jars containing dry maize stalks and damp sand, dry sand and fresh green stalks, or dry sand and dry stalks, most of those in the first two groups pupated within 3 weeks, but none in the last group had done so in 7 weeks and most had died. Pupation occurred earliest in the second group, and pupae were obtained weeks before any occurred in the field. The presence of dry maize stalks during the dry season is almost essential for the survival of *D. lineolata* in Trinidad, and the chief measure of control is the destruction of these, preferably a few weeks before the onset of the rains. Experiments showed that making pen-manure out of the stalks and allowing it to rot in heaps killed all the resting larvae except those in the stalks on the surface of the heaps. The parasites of the two species of *Diatraea* are reviewed from the literature. No egg parasites were observed, but puparia of *Theresia* (*Paratheresia*) *brasiliensis*, Tns., were found in the burrows of *Diatraea* in the dry maize stalks. Empty cocoons of *Apanteles diatraeae*, Mues., were also observed in the stalks, and this Braconid was twice reared from *D. lineolata* in the dry season ; it appeared to be in a resting stage with its host.

Heriot (A. D.) & Waddell (D. B.). **Some Effects of Nutrition on the Development of the Codling Moth.**—*Sci. Agric.* **23** no. 3 pp. 172–175, 8 refs. Ottawa, 1942.

In experiments in British Columbia in 1939–41, larvae of the codling moth [*Cydia pomonella*, L.] were fed exclusively on apple seeds, pulp or leaves or on normal apples. Development was slightly accelerated by an exclusive diet of immature seeds, but seeds were not essential to fertility in the adults. Larvae given immature pulp required only a few days longer for development, but they were the only ones of which a significant number entered diapause. Only 10 cocoons and 3 adults (males) were obtained from 150 larvae confined to mature pulp, though many survived for long periods on it. No larvae completed development on mature seeds. Few of the larvae fed exclusively on leaves completed their development, and the adults derived from them were small and short-lived. Larvae fed on petioles survived for 42 days, but did not complete their development. Leaves picked in the morning did not differ in nutritive value from those picked in the evening.

Petch (T.). **Notes on entomogenous Fungi.**—*Trans. Brit. mycol. Soc.* **25** pt. 3 pp. 250–265. London, 1942.

The species discussed include *Empusa acaricida*, infesting the mite, *Halotydeus destructor*, Tucker, in Western Australia [*cf. R.A.E.*, A **29** 587], *Cordyceps typhulaeformis* and *Isaria* (*Beauveria*) *sphaerocephala*, sp. n., from cocoons of nettle grubs [Limacodids] in South India and Ceylon, respectively, the latter being from *Thosea recta*, Hmps., *Calonectria truncata*, sp. n., from a leafhopper in St. Lucia, *Hymenostilbe aphidis*, sp. n., from Aphids in Dominica, *Cephalosporium aphidicola* from *Capitophorus fragariae*, Theo., on strawberry in Scotland, a species of *Sorosporella*, probably *S.* (*Tarichium*) *uvella*, and *Synglyocladium cleoni* from wireworms in England, and *S. intricatum*, sp. n., from a larva of *Lachnosterna* (*Phyllophaga*) *anxia*, Lec., in Ontario.

Wilson (G. F.). **The Bean Aphis and its Control.**—*J. R. hort. Soc.* **68** pt. 2 pp. 49–52, 2 pls., 1 graph, 5 refs. London, 1943.

Counts of the winter eggs of *Aphis fabae*, Scop., the biology of which is briefly described, have been made on ornamental *Euonymus* at Wisley (Surrey) in each December from 1928 to 1942, during which period they were numerous on nine of the species and varieties examined and absent on the other six. Records of these are given and of the years in which the eggs were more or less abundant than the average. A consideration of recorded outbreaks of *A. fabae* on sugar-beet in central England appears to indicate some correlation between them and the abundance of eggs in the preceding winters at Wisley, and it may therefore be possible to forecast outbreaks, though the correlation between egg-populations in one district and outbreaks in another may not be consistent. The influence of such factors as weather, soil and the age of the plants during the migratory phase, which affect the Aphids during their hatching period and their subsequent rate of reproduction on the primary and secondary food-plants, may prevent the development of high summer populations from high initial egg populations. The date of hatching varies with weather conditions and between 1939 and 1942, inclusive, varied from 20th March to 5th April on *Euonymus*. Alternating periods of high and low temperatures between mid-March and mid-April may result in considerable mortality among the fundatrices.

In experiments on the control of the eggs, tar-oil emulsions at concentrations of 3 and 5 per cent. during December–January gave percentage mortalities of 50–66 and 85–97, respectively, and did not injure any of the deciduous species of *Euonymus*. After the eggs have hatched, dusts of nicotine or sprays of nicotine or pyrethrum extract should be applied to the buds and lower surfaces of the leaves to control the early generations and so reduce the number of alates produced. Several applications of nicotine dust made as soon as the Aphids are observed, preferably at temperatures exceeding 65°F., give effective control on the summer food-plants; nicotine or pyrethrum sprays are also effective when properly applied.

Butovitsch (V.). **Studier över granbarkborrens massförökning i de av decemberstormen 1931 härjade skogarna i norra Uppland.** [Studies on the Outbreaks of the Spruce Bark-beetle in Forests in northern Uppland that were devastated by the Storm of December 1931.]—*Medd. Skogsförsöksanst.* **32** pp. 297–360, 12 figs. Stockholm, 1941. (With a Summary in German pp. 347–360.) [Recd. 1943.]

Observations on the outbreaks of *Ips typographus*, L., on spruce that followed the severe storms in central and southern Sweden in 1931–32 [*cf. R.A.E.*, A **23** 222] were continued in the region of Uppsala in 1934–36, and the results are discussed for a number of separate forest localities. No serious outbreaks occurred in districts in which the forests were damaged by the storms of July 1931 or February 1932, but severe infestation followed that of December 1931, since the amount of fallen timber was so great that it could not all be removed until 1934. This created favourable conditions for an outbreak of bark-beetles, and increases occurred in all districts in which the fallen timber was not removed before the summer of 1932. They were greatest in localities in which trap-logs were not prepared and in those in which the timber was allowed to lie longest, and infestation spread to standing trees. The species that took part in addition to *I. typographus* were *I.* (*Pityogenes*) *chalcographus*, L., which generally followed *I. typographus* but occurred independently of it on young trees with thin bark, and *Polygraphus* sp., which accompanied or followed the two species of *Ips* but under outbreak conditions appeared to prefer uninfested standing trees of all sizes on the edges of infested areas.

In general, the outbreaks passed through two phases, a static one in which infestation was mainly restricted to the fallen timber and which lasted until 1934, and a dynamic one (1934–35), in which migration occurred and the centres of infestation shifted. There was considerable local variation in the way in which the outbreaks developed, depending mainly on the rate at which the fallen timber was removed, and the effects of delay in clearing in the first two years after the storm were still visible 3–4 years later. In areas in which clearing was not complete until the spring of 1933, attack on standing trees occurred in the summer of that year. Its severity varied with the beetle population that had developed in the preceding year and the amount of breeding material available, and in this connection it appeared that it was inadvisable to remove all the fallen timber once the outbreak had begun, since the beetles were then forced to attack standing trees. In such cases, trap-logs were of great use, and in areas in which they were not employed, healthy standing trees were attacked until 1935. In areas in which the fallen timber was not removed until the logging season of 1933–34, attack on standing trees was severe in the summer of 1934, but decreased in 1935 and ceased in 1936. Observations were made in one locality on the rate of multiplication of *I. typographus*. The population reached its peak during the second year after the storm and then decreased until it reached a minimum in the fifth year.

The minor outbreaks of insects on fallen pines had all come to an end within two years of the storm.

RUNGS (C.). **Recherches sur le criquet pèlerin** (*Schistocerca gregaria* **Forsk., Acrididae**) **dans le Maroc méridional français** (**Bassin de l'Oued Drâa**) (**août-octobre 1941**).—*Bull. Soc. Hist. nat. Afr. N.* **33** no. 5–7 pp. 114–136, 3 pls., 8 refs. Algiers, 1943.

In order to investigate possible sources of invasions of Morocco by *Schistocerca gregaria*, Forsk., two expeditions were made by the author, in August–September and in October 1941, to the Draa valley in the Moroccan Sahara. Only two examples were found during the first visit, but a few adults of phase *congregans* were present in mid-October. These were probably advance elements of invading swarms that appeared in the area at the end of October, just after the author had left it. It is suggested that the swarms may have originated during the spring and summer of 1941 in the valley of Seguiet el Hamra, in the Spanish Sahara. A detailed topographical and ecological description of the country, observations on climate, and biometrical data, both for the isolated individuals found and for specimens from the invading swarms, are included.

MAGEE (C. J.), MORGAN (W. L.) & JOHNSTON (A. N.). **Control of Spotted Wilt of Tomatoes.**—*J. Aust. Inst. agric. Sci.* **8** no. 3 pp. 115–117, 2 refs. Sydney, 1942.

Spotted wilt, of which the virus [*Lethum australiense* var. *typicum* of Holmes] is transmitted by *Thrips tabaci*, Lind., and *Frankliniella insularis*, Franklin, has during the last 15 years become the most destructive disease of tomatos in urban areas on the coast of New South Wales and has caused important losses in inland districts in some seasons. Plants have been attacked in the seed bed, after setting out in the field and in various stages of maturity of the crop, but, with a few exceptions, not seriously in glasshouses. Although commercial varieties show pronounced differences in susceptibility to the virus in mild outbreaks, nearly all are liable to 100 per cent. infection during a heavy one.

Earlier work having shown that repellents and contact insecticides did not give effective control of the adult thrips, which transmit the virus from neighbouring infected weeds and crop plants, bait-sprays of tartar emetic were

tested in 1941–42 [*cf. R.A.E.*, A **29** 491]. A spray of 1 oz. tartar emetic, 4 oz. brown sugar and 4 gals. water was applied soon after the seedlings appeared above ground (29th August) and twice a week until they were ready to plant out, and one with double the quantity of tartar emetic once or twice a week in the field from 25th September until 4th December, when the first fruits showed signs of ripening. The treatment reduced the percentage of plants that became infected from 27 to 9 in the plots treated twice a week and 12 in those sprayed once a week, but there was little difference in yield, owing to extreme drought and the high incidence of *Fusarium* wilt. The incidence of spotted wilt was lower than usual in the untreated plots, probably owing to the drought, and it is considered that this method of control should be further tested under conditions of heavy disease incidence. It is concluded that weekly spraying would be commercially profitable where the expected incidence is more than 20 per cent., that spraying in the seed bed would be profitable even under conditions of lower incidence, and that a strength of 1 oz. tartar emetic in 4 gals. would probably be adequate. Tests by growers confirmed these results, and in one of them Paris green showed promise as a substitute for tartar emetic.

Morgan (W. L.) & Pasfield (G.). **Dusts for protecting Bean Seed against *Bruchus* (*Acanthoscelides*) *obtectus* Say.**—*J. Aust. Inst. agric. Sci.* **8** no. 3 pp. 121–122, 1 ref. Sydney, 1942.

Much loss of stored bean seed is caused in New South Wales by *Bruchus* (*Acanthoscelides*) *obtectus*, Say, and control by fumigation [*cf. R.A.E.*, A **31** 184] is not entirely satisfactory. In experiments on the use of inert dusts, small lots of uninfested and infested seed were shaken up with various dusts and kept for 3 months in closed bags to which 50 adult Bruchids were added. The originally uninfested seed was then examined. The best results were given by copper oxychloride, copper carbonate and kaolin, at 1 lb. per bushel, which killed all the adults, prevented any infestation of the seed and did not materially affect germination. Copper carbonate at $\frac{1}{2}$ and $\frac{1}{4}$ lb. permitted 0·1 and 0·2. per cent. infestation, respectively. Sodium fluosilicate and Ceresan, at 2 oz. per bushel, resulted in 4 and 1·9 per cent. infestation. Bentonite, talc, magnesite and hydrated lime, at 1 lb. per bushel, were ineffective. The effective dusts do not prevent larvae already in the seed from giving rise to adults, but they destroy the adults and prevent newly hatched larvae from entering the seeds, provided that these are well covered with dust.

Allman (S. L.). **Foliage Poison Spray for Queensland Fruit Fly. Tartar Emetic and Sodium Fluosilicate compared.**—*Agric. Gaz. N.S.W.* **53** pt. 4 pp. 186–187, 2 figs. Sydney, 1942.

An account is given of three series of cage tests in New South Wales in which tartar emetic was compared with two brands of sodium fluosilicate in bait-sprays [consisting of 2 oz. poison and $2\frac{1}{2}$ lb. white sugar in 4 gals. water (*cf. R.A.E.*, A **31** 136)] for the control of the Queensland fruit-fly [*Dacus ferrugineus tryoni*, Frogg.], when no alternative food was provided, when additional sugar and water was continuously available and when the poison was applied to foliage in a larger cage, to simulate natural conditions, an alternative food supply being available. Tartar emetic was more effective than either form of sodium fluosilicate when the flies were given no other food and showed little loss in efficiency when an alternative was provided, whereas sodium fluosilicate showed a definite decrease [*cf.* **29** 55]. Based on the results of all tests, tartar emetic took two days to kill 50 per cent. or over of the flies and sodium fluosilicate five days. The tests were continued for six days, but complete mortality was not obtained in any

series. Approximately equal numbers of males and females were used, and females were in all cases slightly more resistant than males. Tartar emetic showed no sign of repelling the flies, but sodium fluosilicate appeared to be slightly repellent at the normal concentration (2 oz. in 4 gals. water) and was equally effective at half this rate. In the tests in December, when the normal mean temperature was approximately 70°F., 50 per cent. mortality was obtained in approximately 3½ days, whereas in March, when a cold spell occurred, 40 per cent. mortality was not obtained by the end of a week. Weekly applications to peach trees showed that sodium fluosilicate caused slight foliage injury and roughening of the bark on the young laterals, whereas tartar emetic with sugar caused only a very limited amount of injury to the tips of the leaves and none to the bark; tartar emetic with molasses caused considerable tip burn and some bark injury.

**Insect Pests.**—*Agric. Gaz. N.S.W.* **53** pts. 4, 11, 12 pp. 188–191, 511–516, 559–563, 13 figs. Sydney, 1942.

The first of these parts of a series on insect pests in New South Wales [*cf. R.A.E.*, A **31** 216] includes notes on the bionomics and control of *Cylas formicarius*, F., which sometimes attacks sweet potato on the north coast. The main damage is caused by the larvae in the tubers, both in the field and in storage; the adults may feed on the tubers, stems and leaves. The life-cycle may last only 30 days in warm weather; activity is greatly reduced during winter, but breeding continues. Tubers for propagation should be obtained from localities known to be free from infestation; no tubers should be left in the soil after harvest; all infested tubers and vines should be burned or boiled for pig food; there should be a regular rotation of crops; and clean cultivation should be practised between crops. The seed bed should be as far as possible from the site selected for the main crop, and the tubers used should be destroyed as soon as the young plants are obtained. Where the adults are feeding on the leaves or stems, the plants should be sprayed with 1 lb. lead arsenate in 40 gals. water, or the tops of young plants should be dipped in the mixture when they are transplanted.

The second part comprises brief notes on pests of beans and their control. The most important are *Agromyza phaseoli*, Coq. [*cf.* **26** 335; **28** 564]; *Tetranychus telarius*, L. (*urticae*, Koch) [*cf.* **26** 334]; *Nezara viridula*, L., which is largely controlled by the introduced egg parasite, *Microphanurus basalis*, Woll. [*cf.* **28** 46]; thrips, against which a bait-spray of 1 oz. tartar emetic and 4 oz. sugar in 4 gals. water should be applied as a fine mist under the leaves when the plants are three weeks old and again before blossoming; Aphids, which are controlled by one or more applications of 1 fl. oz. nicotine sulphate and 6½ fl. oz. white oil emulsion in 4 gals. water; and *Bruchus obtectus*, Say, which is also a pest in stored beans [*cf.* **31** 262]. In some seasons, or in localised areas, beans may be attacked by the Capsid, *Megacoelum modestum*, Dist. [*cf.* **28** 606]; *Plusia* spp., against which a spray of 1 lb. cryolite in 40 gals. water or a dust of pyrethrum and kaolin or talc (1 : 3) is suggested; *Heliothis armigera*, Hb.; the bean leafhopper (*Empoasca* sp.); *Zizera* (*Zizeeria*) *labradus*, Godt., the larvae of which sometimes feed on the flowers or pods and can be controlled by dusts of derris powder (1 : 8) or pyrethrum powder (1 : 3) in kaolin or talc, or a spray of 2 oz. derris powder and 2 oz. soap in 4 gals. water; and *Maruca testulalis*, Geyer, which has not been reported since it was recorded in 1939 [**28** 288].

The third part includes a short account of the bionomics and control of the Rutherglen bug, *Nysius* sp. [? *vinitor*, Bergr.], which may disfigure peaches, apricots and cherries so severely that they are useless as either fresh or canning fruit. It is particularly injurious during dry warm weather, when the water content of the soil is low and the plant roots do not obtain enough moisture to

replace that lost in the form of sap from the leaves. Recommended control measures [*cf.* **24** 212] include spraying vegetable crops with a 2½ per cent. emulsion of kerosene in which pyrethrum powder (1 lb. per gal.) has been extracted or dusting them with pyrethrum powder and kaolin or talc (1 : 1) or with nicotine dust (2½ per cent.), treating fruit trees with one of the dusts or a spray of 1½ lb. pyrethrum powder and 1½ lb. soft soap in 40 gals. water and preventing the bugs from crawling on to cultivated land by spraying a band of crude creosote oil or thin tar along the ground on the edge of the area.

TWENTYMAN (R. L.) & PESCOTT (R. T. M.). **Grub Injury to Pastures. A Review of the recent Outbreak.**—*J. Dep. Agric. Vict.* **40** pt. 10 pp. 506–510, 512, 5 figs. Melbourne, 1942.

Injury to pastures in Victoria is caused in most winters by larvae of *Oncopera* sp. and cockchafers, and damage by the latter was unusually severe in that of 1942, particularly in the Western District. *Oncopera* generally attacks pastures or roadsides in which long, dry fodder grass has been allowed to remain since the previous spring and its presence is indicated by the failure of patches of this grass to produce young shoots. Larvae of about eight species of cockchafers were found in pastures in the State, and three of these were common. Most of the damage in 1942 was caused by *Aphodius howitti*, Hope, and the distribution of this and the two other common species, which are unidentified, is shown on a map. Brief notes are given on the bionomics of *A. howitti* [*cf. R.A.E.*, A **26** 209 ; **29** 547], the larvae of which are active from mid-February until the end of August. As a result of their feeding, irregularly-shaped patches become partly or completely bare of grass ; in 1942, pastures 70 or 80 acres in extent were completely denuded, and damage occurred over areas of up to 1,000 acres. The larvae were most active on friable, well-drained soils, and less so on heavy clay soils that tended to crack in the summer. Damage was most severe on pastures consisting of vigorously-growing subterranean clover [*Trifolium subterraneum*] and annual grasses that had been heavily grazed or heavily top-dressed and that would normally provide the best winter grazing. Some of the worst damage occurred on pastures containing subterranean clover and perennial rye-grass [*Lolium perenne*] the growth of which was weakened by unfavourable soil or weather conditions or as a result of mowing for grass and clover hay in spring. Subterranean clover was most susceptible when it succeeded other crops, and less so when it was established in pasture containing native grasses, such as *Phalaris tuberosa*, *Danthonia* and *Microlaena*, which are resistant, or when associated with strongly-growing perennial rye-grass. Damage is generally most severe after a dry autumn, and it has been thought that the increasing activity of the larvae in recent years was due to a succession of dry seasons and would be terminated by a wet winter ; wet weather prevailed in the Western District in 1942, however, and though many larvae were drowned, those on the flooded plains showed considerable resistance unless water remained on the ground for 24 hours. At several places in western Victoria, larvae were killed by a fungus.

Outbreaks are likely to recur on suitable soils as long as climatic and pasture conditions are favourable, and control is hampered by the difficulty of recognising the presence of the larvae before they have become well-established. Recommended preventive measures include increased use of *Phalaris tuberosa* in re-establishing pastures ; ploughing, which appears to give some temporary control, since pastures ploughed 1–3 years previously were unharmed in 1942, whereas others ploughed 4–5 years previously were severely damaged ; and the avoidance of heavy grazing and heavy applications of fertilisers. Pastures that have only been thinned should recover, but unless bare patches are resown with grass, weeds may become established in them. Wheat and oats, but not flax, appear to be resistant. The most satisfactory measure is to plough and

cultivate infested soil and sow it towards the end of July with a mixture of oats and small quantities of perennial ryegrass and *P. tuberosa* ; subterranean clover should become re-established from seed already in the ground. The best treatment for land that cannot be cultivated is to reduce the number of stock grazing on the pasture in summer in an attempt to retain old fodder until the young growth appears in the autumn.

**Queensland. Annual Report of the Department of Agriculture and Stock for the Year 1941–42.**—27 pp. Brisbane, 1942.

The Report of the Director of Plant Industry (Research), by R. Veitch (pp. 5–8), includes notes on entomological investigations. Preliminary tests indicated that the larvae of the cabbage moth [*Plutella maculipennis*, Curt.] can probably be controlled without injury to the cabbage plants by a lead arsenate dust before they heart and by a spray of 1 gal. summer spray oil and 4 lb. soft soap in 60 gals. water afterwards, in place of dusts or sprays of derris, which is now difficult to obtain. Derris dust (1 per cent. rotenone) at the rate of 6 oz. per cwt. protected stored potatoes from reinfestation by the potato tuber moth [*Gnorimoschema operculella*, Zell.] for at least two months after fumigation with carbon bisulphide ; lead arsenate at the same rate was equally effective, but can be used only on seed potatoes. Losses due to the bean fly [*Agromyza phaseoli*, Coq.] were extremely severe during the summer ; in small-scale tests, tar distillates, alone or with petroleum oil, were less effective against it than the recommended spray of nicotine sulphate and white oil, and one of them caused severe scorching of the foliage. Logs that were sprayed with creosote and greased at the ends, to protect them against insect infestation while in short-term storage, were in a satisfactory condition at the end of five months and showed little or no sign of infestation by powder-post beetles [*Lyctus*]. Experiments on the value of starch depletion against these beetles indicated that the effect of high ringing is much the same on red tulip oak [*Tarrietia argyrodendron* var. *peralata*] in north Queensland as on spotted gum [*Eucalyptus maculata*] in south Queensland [*cf. R.A.E.*, A **28** 592]. The corn ear worm [*Heliothis armigera*, Hb.] was not common on cotton until the middle of December, when many eggs were laid in some areas after about an inch of rain had fallen. In the very dry weather that followed, shedding was heavy on rain-grown cotton whether it was infested or not. It has been found that few, if any, larvae of the pink boll worm [*Platyedra scutigera*, Hold.] survive the ginning process since the introduction of improved cleaning machinery.

In the Report of the Director of Cotton Culture (pp. 11–12), W. G. Wells states that the tip worm [*Crocidosema plebeiana*, Zell.], which was the only pest of any consequence attacking seedlings, destroyed a considerable number of terminals in early-planted cotton in the Callide Valley, where it had not previously attracted attention. In autumn, both the cotton looper [*Antarchaea chionosticta*, Turn.] and the rough boll worm [*Earias huegeli*, Rogenh.] were very numerous, but leaf destruction by the former tended to be beneficial, since most of the plants were rank in growth ; the latter destroyed a large proportion of squares and bolls produced late in the season in the central district. *P. scutigera* was present in most districts, but did not appreciably affect crop yields owing to exceptionally good growing conditions ; it is recorded, for the first time from southern Queensland, on cultivated cotton at Lowood.

LEVER (R. J. A. W.). **Pests of the Vegetable Garden and their Control.**—*Agric. J. Fiji* **13** no. 4 pp. 109–115. Suva, 1942.

Additional insects mentioned in this revision of a paper on vegetable pests in Fiji [*R.A.E.*, A **27** 641] are *Nacoleia diemenalis*, Gn., and *Mocis trifasciata*,

Steph., on bean leaves ; *Hippotion celerio*, L., on sweet potato ; *Aphis gossypii*, Glov., which sometimes attacks the leaves of dalo [*Colocasia esculenta*] ; *Nezara viridula*, L., which is chiefly a pest of tomato and beans ; *Lygus muiri*, Popp., injuring young leaves of egg-plant [*Solanum melongena*] ; and the leaf-miners, *Phytomyza spicata*, Mall., on maize, and *Agromyza* (*Liriomyza*) *pusilla*, Mg., on cabbage and cauliflower.

Martin (J. P.) & Pemberton (C. E.). **Disease Symptoms in Lettuce and Celtuce, caused by the Bean Leaf Hopper** *Empoasca solana* **Del.**—*Hawaii. Plant. Rec.* **46** no. 3 pp. 111–118, 8 figs., 1 ref. Honolulu, 1942.

The symptoms of a chlorosis that was observed in lettuce (*Lactuca sativa*) in Hawaii in March 1942 and increased in severity as the weather became hotter and drier are described ; similar symptoms were observed on celtuce (*Lactuca sativa* var. *asparagina*) and endive (*Cichorium endivia*), and field observations showed that some varieties of lettuce were much more tolerant to the injury than others. *Empoasca solana*, DeLong, was extremely common on affected lettuce and celtuce plants in the field and produced severe and characteristic symptoms in a few days when caged on healthy ones, provided that the numbers of leafhoppers per plant were large. The degree of injury varied directly with the insect population, 10 per plant causing none in 10–11 days, and affected plants recovered when the insects were removed. It is concluded that the injury was caused by a toxic secretion injected into the leaf by the insect.

*E. solana* was first collected in Hawaii in 1918 and is probably a recent immigrant. The damage it causes to other plants and other major plant diseases caused by the injection of toxic substances into plants by insects during feeding are discussed.

Cherian (M. C.) & Israel (P.). *Goniozus indicus* **Ash.—a natural Enemy of the Sugarcane White Moth Borer** (*Scirpophaga rhodoproctalis*).—*J. Bombay nat. Hist. Soc.* **43** no. 3 pp. 488–493, 6 refs. Bombay, 1942.

An account is given of the bionomics of the Bethylid, *Goniozus indicus*, Ashm., which was reared from larvae of *Scirpophaga rhodoproctalis*, Hmps. [*cf. R.A.E.*, A **28** 330] on sugar-cane in southern India for the first time in March 1936 and later from *Chilo zonellus*, Swinh., on sorghum. Ashmead's original description of the female is quoted ; it is the species subsequently described by Muesebeck under the same name [*cf.* **29** 137].

The female makes its way into the tunnel of the host, paralyses the larva and deposits 9–40 eggs on it ; it then remains in the tunnel, in which it eventually dies. The larvae feed externally on the host, and the egg, larval, prepupal and pupal stages lasted 2–3, 3–5, 3–6 and 4–7 days. From 9 to 32 adults were obtained from individual hosts, and more than 80 per cent. were females both in the laboratory and in the field. Adult males and females lived for averages of 2 and 20 days, respectively, and unfertilised females gave rise to males only. Parasitism of *Scirpophaga* was heavy in February–April, and only slight in May and June, but breeding continues throughout the year on *C. zonellus*. Experiments showed that only one host is attacked by a given female, even if more are supplied, that pupae are not attacked, and that if a single host is supplied to a number of parasites they attack it and oviposit on it simultaneously.

Rodrigo (E.). **Administration Report of the Acting Director of Agriculture (Ceylon) for 1941.**—15 pp. Colombo, 1942.

A section of this report (p. D5) comprises brief records of investigations carried out in 1941 on insect pests of crops in Ceylon. It is stated that outbreaks of *Scotinophara lurida*, Burm., on rice are due to the unusual prevalence

of weeds on land abandoned after floods and can be controlled by weeding and clean cultivation, and that the Capsids, *Disphinctus politus*, Wlk., and *Helopeltis antonii*, Sign., have been found to cause shoot dieback of cashew [*Anacardium occidentale*] by the injection of a toxin when feeding.

POSNETTE (A. F.). **Natural Pollination of Cocoa,** *Theobroma leiocarpa,* **on the Gold Coast.**—*Trop. Agriculture* **19** no. 1 pp. 12–16, 8 refs. Trinidad, 1942. **Natural Pollination of Cocoa,** *Theobroma leiocarpa,* **Bern., on the Gold Coast II.**—*T.c.* no. 10 pp. 188–191, 6 refs.

The investigations described in these papers were carried out in 1938–40 and 1940–41, respectively. All the evidence obtained during the first period indicated that the flowers of cacao are pollinated by insects [*cf. R.A.E.*, A **30** 230]. During the profuse flowering period (May–August), only about 10 per cent. of the flowers are pollinated, but the percentage shows considerable variation and appears to be determined by the size of the insect populations rather than by the number of flowers. When flowers are less numerous (August–February), insects are able to visit nearly all of them, and the percentage to be pollinated is consistently high ; over 77 per cent. on 64 trees were pollinated between 13th November 1938 and 6th February 1939. In tests of the efficiency of six species of ants in May–October 1940, only *Crematogaster* (*Sphaerocrema*) sp. effected pollination, but in further tests between October 1940 and September 1941, when it was established that this ant is responsible for a large proportion of the pollination, a closely-related species, *Crematogaster* (*Acrocoelia*) sp., was also found to effect some, although another species of this subgenus had previously proved ineffective. Ants appear to cause about half the total pollination and most of that effected by them is probably self-pollination ; unidentified flying diurnal insects that are not continuously present account for the other half, which probably represents cross-pollination. Aphids appear to be of no significance.

TOOKE (F. G. C.) & HUBBARD (C. S.). **The Pine Tree Emperor Moth** *Nudaurelia cytherea capensis,* **Stoll. A Survey and Examination of the Measures employed in its Control.**—*Sci. Bull. Dep. Agric. For. S. Afr.* no. 210, 57 pp., 4 col. pls., 8 figs., 4 refs. Pretoria, 1941. [Recd. 1943.]

Two races or subspecies of *Nudaurelia cytherea*, F., are present in South Africa [*cf. R.A.E.*, A **29** 18], the typical one, which is rare and appears to be restricted to the Transvaal and Natal and of which the larvae and their food-plants are unknown, and *capensis*, Cram., which occurs in the Cape Province, has recently spread to Natal, and has become adapted to feeding on pines, particularly *Pinus radiata* (*insignis*), on which it causes severe defoliation. This paper comprises an account of the bionomics of this subspecies, all stages of which are described, notes on the intensity of infestation and extent of damage by it, an account of outbreaks that have occurred in South Africa since 1885, and a detailed discussion of the effectiveness of various methods of control.

A list is given of the native plants and exotic trees and shrubs on which the larvae feed ; they include some 27 species, of which 7 are pines. *Rhus angustifolia* is considered to be a natural food-plant, since it is generally defoliated and is preferred for oviposition, even by females derived from a stock reared for several generations on pine. Apple, quince and guava are attacked, but are unlikely to be seriously damaged, since the eggs and larvae are not present until the leaves are falling or the trees bare. On pines, the eggs are deposited in groups of 3–100, usually on the branches and foliage of the upper part of the crown. The larvae are gregarious for a time, and if the food-supply

is exhausted before they are full-fed, they migrate to another tree. The larval stage occupies 6–8 weeks or more, and pupation takes place in the soil. The adults, which live for only a few days, are active on clear or moonlight evenings and mornings, but are sluggish during hot or wet weather. Each female lays 150–200 eggs.

There are two biological strains of *N. c. capensis* [*loc. cit.*] with differing seasonal cycles. The adults of the commoner, which occurs in Cape Province, chiefly in the west, emerge from the latter part of April until mid-June, the egg stage lasts 3–4 weeks, and the larvae pupate in October–December. The other strain occurs in the east of the Province and in Natal and has only twice been recorded in injurious numbers. The adults emerge from January until April, and pupation occurs in July–August.

Observations over several years indicate that the probable intensity of infestation in spring can be estimated from the number of dead adults present on the forest floor at the end of the preceding June. An average of more than two adults to three trees is likely to be followed by partial or total defoliation of *P. radiata*, and damage is likely to be negligible when fewer are present. Infestation may also be estimated from the number of pupae in the soil to a depth of 4 ins. within a radius of at least 2 ft. from each tree : economic damage is to be expected when the population exceeds 0·8 per tree. In addition to the injury to the trees resulting from loss of vigour and increment due to defoliation, the leading shoots may be killed for a distance of 10 feet or more as a result of exposure to the sun. The trees never recover completely from this type of injury.

The available control measures comprise hand-collection of all stages, which is ineffective and costly, and the use of pigs to destroy the pupae [**24** 335 ; **28** 191 ; **30** 33], which has proved both cheap and effective. Comprehensive experiments, which are described in detail, showed that the pupae are not toxic to pigs in the field. Attempted control by means of calcium arsenate dust in 1934 was not successful, and the prospects of control by insecticides are poor, owing to the cost and the difficulty of application in the type of terrain in which most of the plantations occur. A number of stomach and contact poisons were tested, however, and of these natural and synthetic cryolite and a native ore consisting of almost pure calcium fluoride gave the most promising results [*cf.* **30** 33]. Derris and pyrethrum dusts were effective against larvae in the third instar, but not against the later stages. There was an indication that calcium arsenate and lead arsenate were more effective at the rate of 30 lb. per acre than at lower and higher rates.

Outbreaks of this Saturniid on native plants are usually controlled by natural factors after two or three years, but outbreaks lasting eight or ten years have been recorded in pine plantations. The eggs are parasitised by three species of Hymenoptera and the larvae by the Braconid, *Apanteles maculitarsis*, Cam., but the percentages destroyed are not great. Natural control is chiefly effected by a polyhedral wilt disease and another disease of which the causal organism is unknown, which together or separately cause high larval mortality, usually approaching 90 per cent. At one place, baboons have been stated to destroy considerable numbers of all stages.

STEINHAUS (E. A.). **Catalogue of Bacteria associated extracellularly with Insects and Ticks.**—Demy 8vo, [1+] iii+206 pp., many refs. Minneapolis, Minn., Burgess Publ. Co., 1942. Price $2.00.

After a preliminary section that consists of a summary of pertinent literature on many biological relationships between Arthropods and extracellular bacteria that could not be dealt with satisfactorily under the individual species of bacteria, the latter are recorded in alphabetical order under Orders, families,

tribes and genera, the system of classification being that used in Bergey's Manual of Determinative Bacteriology (1939, 5th edn.). Under the heading of each species is given the name of the Arthropod or Arthropods concerned with it, followed by a synopsis of the nature of the relationship and references to the literature, including the paper in which the bacterium was originally described or mentioned. It is considered that these synopses will be of particular value to workers dealing with bacterial diseases of insects and the bacterial diseases transmissible directly or indirectly by insects and ticks to man and animals or by insects to plants.

BAERG (W. J.). **Introduction to applied Entomology.**—2nd edn. Demy 4to, [1+] vii+146 pp., frontis., 128 figs., many refs., multigraph. Minneapolis, Minn., Burgess Publ. Co., 1942. Price $2.25 *cts.*

This book, which is designed for students of agriculture and entomology, deals principally with the more important insect and Arachnid pests of crops, domestic animals and man in the United States. It consists chiefly of notes on the bionomics and control of individual species, followed by references to the literature on them, but also contains a section on the anatomy, life-history and economic importance of insects and one on control, in which the characteristics and uses of the principal insecticides are summarised.

**Thirty-fifth, Thirty-sixth and Thirty-seventh annual Reports of the Department of Agriculture (British Columbia) for the Years 1940, 1941 and 1942.**—120, 136, 144 pp. Victoria, B.C., 1941, 1941, 1942. [Recd. 1943.]

The Reports of the Horticultural Branch for 1940 (pp. H32–H49), 1941 (pp. Y26–Y45), and 1942 (pp. X26–X46), by W. H. Robertson, include information on orchard pests and on the Colorado potato beetle [*Leptinotarsa decemlineata*, Say]. The latter was less numerous in 1940 than in previous years [*R.A.E.*, A **27** 67; **29** 22] and there was a further reduction in 1941. Dusts of calcium arsenate and lime were used in all three years, and rotenone dusts gave promising results in 1942.

The Pacific mite [*Tetranychus pacificus*, McG.] was widely distributed in 1940 in orchards in the districts in the Okanogan Valley in which it was observed in 1939 [*cf.* **29** 330], but caused less damage. It was successfully controlled during the growing season, when temperatures were quite high, by a spray containing 1 quart commercial lime-sulphur, 1 lb. zinc sulphate and $\frac{1}{4}$ lb. casein spreader in 100 gals. water, which did not injure the trees. Owing to favourable weather conditions, infestation of apple by the codling moth [*Cydia pomonella*, L.] was severe in 1940, when cryolite was again substituted for lead arsenate in sprays against the second generation [**29** 330] with satisfactory results and cryolite with a casein-lime spreader proved very effective [*cf.* **31** 212]. The populations of overwintering larvae in the spring of 1941 were the highest yet recorded, and this factor, combined with a light crop, windy and rainy weather that interfered with spraying operations and a shortage of satisfactory spraying equipment, resulted in severe damage in many orchards. Attempts to destroy the overwintering larvae on the trunks and rough bark of the branches by means of sprays containing kerosene or diesel oil and dinitro-o-cresol were successful; many of the trees were injured by the oil [**31** 97], but in the following year no deleterious effect on their growth could be detected. Sprays containing lead arsenate or cryolite were rendered more effective by the addition of oil in both 1941 and 1942, and its inclusion in some of the sprays against the first generation appears advisable; it should not be used against the second, as the deposit is difficult to remove. In

1942, overwintered larvae were not abundant, and cold weather in spring prevented the production of large populations during the year. Work on control showed that synthetic and natural cryolites with a spreader are equally effective, and sprays containing these substances or nicotine bentonite and oil compare favourably with sprays containing equal quantities of lead arsenate. The standard spray containing $3\frac{3}{4}$ lb. lead arsenate and a spreader in 100 gals. was less effective than one containing half this quantity of phenothiazine or than one containing 5 lb. calcium arsenate, $2\frac{1}{2}$ lb. lime and $1\frac{1}{4}$ lb. zinc sulphate per 100 gals. The apple mealybug [*Phenacoccus aceris*, Sign.] decreased in numbers in the Kootenays in 1940, but heavy infestations developed in the following year ; even temperatures and adequate moisture in 1942 were also favourable for this Coccid. Experiments on its control by emulsions of dormant oil alone or with lime-sulphur, both at reduced concentrations, were carried out in 1940–41 [*cf.* **31** 152]. The sprays recommended in 1942 were 4 per cent. dormant oil (viscosity 110) or 6 per cent. diesel oil (viscosity 44), which is cheaper ; 4 per cent. of the latter is as effective if uniform application is obtainable.

Peaches were severely damaged by the tarnished plant bug [*Lygus oblineatus*, Say] in 1941, when losses of 40 per cent. were recorded, but infestation was so light in 1942 that no damage was done, even to unsprayed trees. As the control measures in general use have not proved satisfactory, experiments were made in 1941 to discover more effective ones. In small-scale trials, 6-year-old trees with a dense cover-crop of lucerne were dusted with pyrethrum just before the blossoms opened and again as they were falling. By the time the fruits were the size of walnuts, the percentage infestation was reduced from 19·3 to 2·9 on one variety, and from 22·0 to 6·8 on another that is normally the most susceptible. Trials on a larger scale in 1942 gave inconclusive results owing to the light infestation.

Surveys undertaken in all three years following the report of the presence of the pear psylla [*Psylla pyricola*, Först.] in Washington [**29** 425] resulted in the discovery of this Psyllid in over 100 orchards in four localities in British Columbia in 1942. Infestation was moderate in one orchard and slight in all the others. Sprays containing oil with nicotine and rotenone applied on 19th August gave satisfactory control, probably owing to hot weather at the time of application, and did not damage the trees.

In the Reports of the Provincial Entomologist for 1940 (pp. H56–H57), 1941 (pp. Y51–Y53) and 1942 (p. X62), M. H. Ruhmann gives records of the prevalence of the principal insect pests. Those recorded in 1940 include *Plusia* (*Autographa*) *californica*, Speyer, which attacked lucerne, carrots and onions, and was controlled by an arsenical dust, *Taeniothrips simplex*, Morison, on *Gladiolus* (also reported in 1942), *Thrips tabaci*, Lind., on onions and carrot, *Hylemyia cilicrura*, Rond., which extended its range but again attacked only beans [*cf.* **29** 330], and *Bruchus* (*Mylabris*) *pisorum*, L., on peas. *H. antiqua*, Mg., showed increased activity in the Okanagan Valley in 1941 and 1942, and in the latter year was as injurious as wireworms to seedling onions. Other insects reported in 1941 were *Psila rosae*, F., on carrots, *Protoparce quinquemaculata*, Haw., which attacked tomatos in a district in which this crop had been grown on a large scale for the first time in 1940, and cutworms, which were also very injurious to the tomatos. Where cutworm control was attempted by scattering a poison bait of Paris green and bran, many plants were destroyed as a result of contact with it. *Heliothis armigera*, Hb. (*obsoleta*, F.) is injurious after mild winters, and in 1941, which was the third of three successive mild winters, caused more damage to maize in the interior than at any other time since it was first recorded in British Columbia some 20 years previously. In the same year, lilac hedges in the Okanagan Valley were attacked by *Gracilaria syringella*, F., and orchard trees and poplar were defoliated by *Malacosoma disstria*, Hb., the larvae of which were heavily parasitised.

PUTMAN (W. L.). **Host Plants and Parasites of some Lepidopterous Larvae.**—*Canad. Ent.* **74** no. 12 pp. 219–224, 2 refs. Guelph, Ont., 1942.

Records are given of the food-plants of upwards of 90 species of Lepidoptera from Ontario not included in a previous list [*R.A.E.*, A **23** 450] and of the parasites of some of them.

FLANDERS (S. E.). **Red Scale Parasites. Comparison of oriental Races of *Comperiella bifasciata* in California.**—*Calif. Citrogr.* **28** no. 3 p. 78. Los Angeles, Calif., 1943.

Investigations in California have shown that there are two races of *Comperiella bifasciata*, How., based on the ability of the eggs to hatch when deposited in the blood of the red scale [*Aonidiella aurantii*, Mask.]; one, obtained from Japan in 1925, produces an average of two offspring per egg-laying female when allowed to oviposit in second-stage red scale [*cf. R.A.E.*, A **28** 264, etc.], and the other, obtained from China in 1941, averages 50 under similar conditions. When the races are crossed, the hatching ability of the eggs is that of the maternal race, but the eggs deposited by hybrids have the hatching capacity of the Japanese race. When a female of the Japanese race deposits all its eggs in second-stage *A. aurantii*, few if any of the eggs hatch; in one case a female had 14 progeny. When a female of the Chinese race does so, however, almost all the eggs hatch, and in one case a female had 136 progeny. The Chinese race, however, has shown no indication of controlling *A. aurantii* under field conditions, and both races are greatly handicapped by the occurrence on the tree of old scale coverings; the female must drill through the coverings in its search for a suitable host, and this, together with a short adult life, greatly lowers its searching capacity. The parasite is more effective against the yellow scale [*A. citrina*, Coq.], which occurs only on the leaves and fruit, with the result that old scale coverings are removed by the dropping of the leaves and picking of the fruit; the Japanese race has been established in California *Citrus* orchards for twelve years and annually destroys large numbers of yellow scale in some districts [*cf.* **30** 593]. The parasite oviposits in all stages except the egg of both scales; there is a high mortality of the offspring in young hosts, and the older the scales in which they develop, the more rapidly they reach maturity.

MARCOVITCH (S.) & STANLEY (W. W.). **Fluorine Compounds useful in the Control of Insects.**—*Bull. Tenn. agric. Exp. Sta.* no. 182, 46 pp., 24 figs., 96 refs. Knoxville, Tenn., 1942.

The major results of experimental work carried out in Tennessee since 1924 with the various fluorine compounds, which are the best inorganic substitutes for arsenicals, are collected in this bulletin. A brief review of references in the literature to the use of these compounds as insecticides is followed by notes on the chemical properties, uses and toxicity to man of sodium fluoride, sodium fluosilicate and cryolite. Sodium fluoride is used against cockroaches, other household insects and lice on cattle and poultry, and sodium fluosilicate chiefly in baits for grasshoppers and other insects and as a moth-proofing agent. Cryolite has been used in sprays and dusts on fruit and vegetable crops, sugar-cane, tobacco and cotton, and is about as toxic as lead arsenate to most insects; it appears to be particularly effective against *Heliothis armigera*, Hb. It is not poisonous to man and the higher animals, does not injure foliage or cause soil poisoning and is compatible with arsenicals and fungicides such as sulphur or insoluble copper compounds, but not with lime. Barium fluosilicate shows no particular advantage over cryolite and occasionally causes slight foliage injury and damage to the valves of spray pumps.

The effect of fluorine on the teeth, which is the basis of the United States tolerance of 0·02 grain per lb. of fruit, is discussed in some detail, and it is concluded that the restrictions are unnecessary.

COOMBER (H. E.), MARTIN (J. T.) & HARPER (S. H.). **The Determination of Rotenone in Derris Root.**—*J. Soc. chem. Ind.* **61** pp. 110–112, 1 fig. London, 1942.

An improved method for estimating rotenone in derris root, employing the carbon tetrachloride complex separation, is described. It has been shown by three groups of workers to give concordant results with various types of root. Methods of determining moisture content and chloroform extract are also given. Their adoption in the United Kingdom as standard methods is recommended.

PAPERS NOTICED BY TITLE ONLY.

ROBERTS (H. R.). **Two Subspecies of *Melanoplus differentialis* and related new Species from Mexico with Discussion of their Variations (Orthoptera : Acrididae : Cyrtacanthacridinae).**—*Trans. Amer. ent. Soc.* **68** no. 3 pp. 151–165, 2 pls., 1 map, 5 refs. Philadelphia, Pa., 1942.

HINTON (H. E.). **Secondary Sexual Characters of *Tribolium* [*confusum*, Duv., and *T. castaneum*, Hbst.].**—*Nature* **149** no. 3783 pp. 500–501, 1 fig., 3 refs. London, 1942.

MARTIN (H. E.) & HARE (L.). **The nutritive Requirements of *Tenebrio molitor* Larvae.**—*Biol. Bull.* **83** no. 3 pp. 428–437, 1 fig., 4 refs. Lancaster, Pa., 1942.

BOTTGER (G. T.). **Development of synthetic Food Media for Use in Nutrition Studies of the European Corn Borer** [larvae of *Pyrausta nubilalis*, Hb.]. —*J. agric. Res.* **65** no. 10 pp. 493–500, 3 refs. Washington, D.C., 1942.

GORHAM (R. P.). **A simple Method for Use in staining living Aphids.**—*Canad. Ent.* **74** no. 12 p. 236. Guelph, Ont., 1942.

HUTZEL (J. M.) & PETERSON (A.). **A killing and preserving Fluid for immature Insects.**—*J. econ. Ent.* **35** no. 5 p. 788. Menasha, Wis., 1942.

BOYCE (A. M.), PERSING (C. O.) & BARNHART (C. S.). **The Resistance of Citrus Thrips** [*Scirtothrips citri*, Moult.] **to Tartar Emetic-Sucrose Treatment** [in California].—*J. econ. Ent.* **35** no. 5 pp. 790–791, 3 refs. Menasha, Wis., 1942. [For fuller account see *R.A.E.*, A **31** 209.]

COLCORD (M.). **Index VI to the Literature of American Economic Entomology January 1, 1935 to December 31, 1939.**—*Amer. Ass. econ. Ent.*, Spec. Publ. 6, [12+] 815 pp. College Park, Md., 1942. Price $6.00. Postage 50 *cents*. [*Cf. R.A.E.*, A **26** 367.]

SMITH (R. C.). **Guide to the Literature of the Zoological Sciences.**—Demy 4to, [1+] vii+128 pp. multigraph. Minneapolis, Minn., Burgess Publ. Co., 1942. Price $2.00.

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